

## INTERNATIONAL SEARCH REPORT

national Application No

PCT/US 01/45717

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 A61K39/39 A61P31/00 A61P35/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 A61K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, BIOSIS, PAJ, WPI Data

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 99 29728 A (GALLO ROBERT C.; DEVICO ANTHONY L (US); GARZINO DEMO ALFREDO (US);) 17 June 1999 (1999-06-17)  the whole document --- -/--	1-6, 8-14, 17, 18, 20-26, 29, 32-39, 42-45, 47-50, 67, 68

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>EP 0 974 357 A (SCHERING PLOUGH CORP) 26 January 2000 (2000-01-26)</p> <p>the whole document</p>	<p>1-11, 13, 14, 17-24, 29, 32-40, 42-49, 67, 68</p>
X	<p>WO 98 04282 A (GRAF MARTIN R ; GRANGER GALE A (US); HISERODT JOHN C (US); UNIV CAL) 5 February 1998 (1998-02-05) abstract page 7, line 3 - line 26 page 8, line 32 - page 10, line 28 page 11, line 33 - line 37 page 12, line 34 - line 38 page 14, line 39 - page 15, line 27 page 16, line 6 - line 16 page 26, line 15 - last line examples 5-7</p>	<p>50-66</p>
X	<p>DE GIOVANNI CARLA ET AL: "The prospects for cancer gene therapy." INTERNATIONAL JOURNAL OF IMMUNOPHARMACOLOGY, vol. 22, no. 12, December 2000 (2000-12), pages 1025-1032, XP002218907 ISSN: 0192-0561 the whole document</p>	<p>1, 37, 50, 54</p>
A	<p>GREAVES DAVID R ET AL: "Chemokines and myeloid cell recruitment." MICROBES AND INFECTION, vol. 2, no. 3, March 2000 (2000-03), pages 331-336, XP002218908 ISSN: 1286-4579 the whole document</p>	
P, X	<p>WO 01 80887 A (TALBOT DALE ; SCHALL THOMAS J (US); CHEMOCENTRYX INC (US)) 1 November 2001 (2001-11-01) the whole document</p>	<p>1-49</p>



## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(21) International Application Number:</b> PCT/US98/26291 <b>(22) International Filing Date:</b> 11 December 1998 (11.12.98)  <b>(30) Priority Data:</b> 60/069,281 11 December 1997 (11.12.97) US  <b>(63) Related by Continuation (CON) or Continuation-in-Part (CIP) to Earlier Application</b> US 60/069,281 (CON) Filed on 11 December 1997 (11.12.97)  <b>(71) Applicant (for all designated States except US):</b> UNIVERSITY OF MARYLAND BIOTECHNOLOGY INSTITUTE [US/US]: 4321 Hartwick Road, College Park, MD 20740 (US).  <b>(72) Inventors; and</b> <b>(75) Inventors/Applicants (for US only):</b> GALLO, Robert, C. [US/US]; 8513 Thornden Terrace, Bethesda, MD 02817 (US). DEVICO, Anthony, L. [US/US]; 4533 Peacock Avenue, Alexandria, VA 22304 (US). GARZINO-DEMO, Alfredo [IT/US]; 601 North Eutaw Street, Baltimore, MD 21201 (US).		<b>(74) Agent:</b> BARRETT, William, A.; Intellectual Property/Technology Law, P.O. Box 14329, Research Triangle Park, NC 27709 (US).  <b>(81) Designated States:</b> AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>
<b>(54) Title:</b> METHOD AND COMPOSITION TO ENHANCE THE EFFICACY OF A VACCINE USING CHEMOKINES  <b>(57) Abstract</b>  The present invention relates to a method to enhance the efficacy of a vaccine in a subject treated with the vaccine comprising administering to the subject in combination with the vaccine a one or more chemokines. The present invention also relates to compositions of vaccines containing chemokines.		

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## METHOD AND COMPOSITION TO ENHANCE THE EFFICACY OF A VACCINE USING CHEMOKINES

### 1. CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority to U.S. Application Serial No. 60/069,281 filed December 11, 1997.

### 2. BACKGROUND OF THE INVENTION

The present invention relates to a method to enhance the efficacy of a vaccine by administration of a chemokine, such as macrophage derived chemokine (MDC), in conjunction with the vaccine. The present invention also relates to compositions useful in the method.

#### 2.1. GENERATION OF AN IMMUNE RESPONSE

The introduction of a foreign antigen into an individual elicits an immune response consisting of two major components, the cellular and humoral immune responses, mediated by two functionally distinct populations of lymphocytes known as T and B cells, respectively (see generally Coutinho, 1991, Immune System, *Encyclopedia of Human Biology*, Vol. 4, Ed. Dulbecco, Academic Press, Inc.). A subset of T cells responds to antigen stimulation by producing lymphokines which "help" or activate various other cell types in the immune system.

Another T cell subset is capable of developing into antigen-specific cytotoxic effector cells, which can directly kill antigen-positive target cells. On the other hand, the B cell response is primarily carried out by secretory proteins, antibodies, which directly bind and neutralize antigens.

Helper T cells (TH) can be distinguished from classical cytotoxic T lymphocytes (CTL) and B cells by their cell surface expression of the glycoprotein marker CD4. Although the mechanism by which CD4<sup>+</sup> TH function has not been fully elucidated, the existence of functionally distinct subsets within the CD4<sup>+</sup> T cell compartment has been reported (Mosmann and Coffman, 1989, *Ann. Rev. Immunol.*

7:145-173). In the mouse, type 1 helper T cells (TH1) produce interleukin-2 (IL-2) and  $\tau$ -interferon ( $\tau$ -IFN) upon activation, while type 2 helper T cells (TH2) produce IL-4 and IL-5. Based on the profile of lymphokine production, TH1 appear to be involved in promoting the activation and proliferation of other T cell subsets including CTL, whereas TH2 specifically regulate B cell proliferation and differentiation, antibody synthesis, and antibody class switching.

A second T cell subpopulation is the classical CTL which express the CD8 surface marker. Unlike most TH, these cells display cytolytic activity upon direct contact with target cells, rather than through the production of lymphokines. *In vivo*, CTL function is particularly important in situations where an antibody response alone is inadequate. Significant experimental evidence indicates that CTL rather than B cells and their antibody products play a principal role in the defense against viral infections and cancer.

A salient feature of both T and B cell responses is their exquisite specificity for the immunizing antigen; however, the mechanisms for antigen recognition differ between these two cell types. B cells recognize antigens by antibodies, either acting as cell surface receptors or as secreted proteins, which bind directly to antigens on a solid surface or in solution, whereas T cells only recognize antigens that have been processed or degraded into small fragments and presented on a solid phase such as the surface of antigen-presenting cells (APC). Additionally, antigenic fragments must be presented to T cells in association with major histocompatibility complex (MHC)-encoded class I or class II molecules. The MHC refers to a cluster of genes that encode proteins with diverse immunological functions. In man, the MHC is known as HLA. Class I gene products are found on all somatic cells, and they were originally discovered as targets of major transplantation rejection responses. Class II gene products are mostly expressed on cells of various hematopoietic lineages, and they are involved in cell-cell interactions in the immune system. Most importantly, MHC-encoded proteins have been shown to function as receptors for processed antigenic fragments on the surface of APC (Bjorkman et al., 1987, *Nature* 329:506-512).

Another level of complexity in the interaction between a T cell and an antigenic fragment is that it occurs only if the MHC molecules involved are the same on the APC and the responding T cells. In other words, a T cell specific for a particular antigenic epitope expresses a receptor having low affinity for self MHC

proteins, which when such MHC proteins on APC are occupied by the epitope, engage the T cell in a stronger interaction leading to antigen-specific T cell activation. The phenomenon of a T cell reacting with a processed antigen only when presented by cells expressing a matching MHC is known as MHC-restriction.

The specificity of T cell immune responses for antigens is a function of the unique receptors expressed by these cells. The T cell receptor (TCR) is structurally homologous to an antibody; it is a heterodimer composed of disulfide-linked glycoproteins. Four TCR polypeptide chains known as  $\alpha$ ,  $\beta$ ,  $\tau$ , and  $\delta$  have been identified, although the vast majority of functional T cells express the  $\alpha\beta$  heterodimeric TCR. Transfer of  $\alpha$  and  $\beta$  genes alone into recipient cells was shown to be both necessary and sufficient to confer antigen specificity and MHC-restriction (Dembic et al., 1986, *Nature* 320:232-238). Thus, the  $\alpha\beta$  TCR appears to be responsible for recognizing a combination of antigenic fragment and MHC determinants.

The apparent basis of MHC restriction is that  $CD4^+$  T cells express  $\alpha\beta$  TCR which recognize antigenic fragments physically associated with MHC class II proteins, while the TCR on  $CD8^+$  CTL recognize MHC class I-associated fragments. Thus,  $CD4^+$  T cells can recognize only a restricted class of APC that are class II<sup>+</sup>, whereas  $CD8^+$  CTL can interact with virtually any antigen-positive cells, since all cells express class I molecules.  $CD4^+$  CTL have been identified, and they are MHC class II restricted, and lyse target cells only if the latter express self-MHC class II determinants associated with specific antigenic fragments. Both CD4 and CD8 molecules also contribute to this interaction by binding to monotypic determinants on the MHC class II and I molecules, respectively.

A second type of TCR composed of  $\tau\delta$  heterodimers is expressed by a small percentage of T cells, but the involvement of  $\tau\delta$  T cells in antigen-specific recognition is still poorly understood. Some studies have shown that functionally active  $\tau\delta$  T cells can be cytolytic in a MHC non-restricted manner.

In summary, the generation of an immune response begins with the sensitization of  $CD4^+$  and  $CD8^+$  T cell subsets through their interaction with APC that express MHC-class I or class II molecules associated with antigenic fragments. The sensitized or primed  $CD4^+$  T cells produce lymphokines that participate in the activation of B cells as well as various T cell subsets. The sensitized  $CD8^+$  T cells increase in numbers in response to lymphokines and are capable of destroying any

cells that express the specific antigenic fragments associated with matching MHC-encoded class I molecules. For example, in the course of a viral infection, CTL eradicate virally-infected cells, thereby limiting the progression of virus spread and disease development.

## 2.2. ANTIGEN PRESENTING CELLS

The presentation of antigens to T cells is carried out by specialized cell populations referred to as antigen presenting cells (APC). Typically, APC include macrophages/monocytes, B cells, and bone marrow derived dendritic cells (DC). APC are capable of internalizing exogenous antigens, cleaving them into smaller fragments in enzyme-rich vesicles, and coupling the fragments to MHC-encoded products for expression on the cell surface (Goldberg and Rock, 1992, *Nature* 357:375-379). Since APC express both MHC-encoded class I and class II glycoproteins, they can present antigenic fragments to both CD4<sup>+</sup> and CD8<sup>+</sup> T cells for the initiation of an immune response.

By definition, APC not only can present antigens to T cells with antigen-specific receptors, but can provide all the signals necessary for T cell activation. Such signals are incompletely defined, but probably involve a variety of cell surface molecules as well as cytokines or growth factors. Further, the factors necessary for the activation of naive or unprimed T cells may be different from those required for the re-activation of previously primed memory T cells. The ability of APC to both present antigens and deliver signals for T cell activation is commonly referred to as an accessory cell function. Although monocytes and B cells have been shown to be competent APC, their antigen presenting capacities *in vitro* appear to be limited to the re-activation of previously sensitized T cells. Hence, they are not capable of directly activating functionally naive or unprimed T cell populations.

Although it had been known for a long time that APC process and present antigens to T cells, it was not shown until relatively recently that small antigenic peptides could directly bind to MHC-encoded molecules (Babbitt et al., 1985, *Nature* 317:359; Townsend et al., 1986, *Cell* 44:959). However, it is believed that, normally, complex antigens are proteolytically processed into fragments inside the APC, and become physically associated with the MHC-encoded proteins intracellularly prior to

trafficking to the cell surface as complexes. Two distinct pathways for antigen presentation have been proposed (Braciale et al., 1987, *Immunol. Rev.* 98:95-114). It was thought that exogenous antigens were taken up by APC, processed and presented by the exogenous pathway to class II restricted CD4<sup>+</sup> T cells, while the endogenous pathway processed intracellularly synthesized proteins, such as products of viral genes in virally-infected cells, for association with MHC class I proteins and presentation to CD8<sup>+</sup> CTL. However, although the two pathways in antigen processing and presentation may still be correct in some respects, the distinction is blurred in light of recent findings that exogenously added antigens may also be presented to class I-restricted CTL (Moore et al., 1988, *Cell* 54:777).

The term "dendritic cells" (DC) refers to a diverse population of morphologically similar cell types found in a variety of lymphoid and non-lymphoid tissues (Steinman, 1991, *Ann. Rev. Immunol.* 9:271-296). These cells include lymphoid DC of the spleen, Langerhans cells of the epidermis, and veiled cells in the blood circulation. Although they are collectively classified as a group based on their morphology, high levels of surface MHC-class II expression, and absence of certain other surface markers expressed on T cells, B cells, monocytes, and natural killer cells, it is presently not known whether they derive from a common precursor or can all function as APC in the same manner. Further, since the vast majority of published reports have utilized DC isolated from the mouse spleen, results from these studies may not necessarily correlate with the function of DC obtained from other tissue types. (Inaba et al., 1997, *J. Exp. Med.* 166:182-194; Hengel et al., 1987, *J. Immunol.*, 139:4196-4202; Kaut et al., 1988, *J. Immunol.*, 140:3186-3193; Romani et al., 1989, *J. Exp. Med.* 169:1169-1178; Macatonia et al., 1989, *J. Exp. Med.* 169:1255-1264; Inaba et al., 1990, *J. Exp. Med.* 172:631-6640). For example, despite high levels of MHC-class II expression, mouse epidermal Langerhans cells, unlike splenic DC, are not active APC in mixed leucocyte reaction (MLR), unless cultured with granulocyte-macrophage colony stimulating factor (GM-CSF) (Witmer-Pock et al., 1987, *J. Exp. Med.* 166:1484-1498; Heufler et al., 1988, *J. Exp. Med.* 167:700-705). Most human Langerhans cells express the CD1 and CD4 markers, while blood DC do not. Additionally, it has not been established the extent to which the functional characteristics observed with mouse DC are applicable to human DC, especially the DC obtained from non-splenic tissues; in part, due to inherent differences between the



human and murine immune systems.

Recently, a few studies have described the isolation of human DC from the peripheral blood, which involves the use of sheep red blood cells and/or fetal calf serum (Young and Steinman, 1990, *J. Exp. Med.* 171:1315-1332; Freudenthal and Steinman, 1990, *Proc. Natl. Acad. Sci. USA* 87:7698-7702; Macatonia et al., 1989 *Immunol.* 67:285-289; Markowicz and Engleman, 1990, *J. Clin. Invest.* 85:955-961). Engleman et al. described a partial purification procedure of DC from human blood, which does not involve the use of sheep red blood cells and/or fetal calf serum, and showed that the partially purified human DC can, in fact, present exogenous antigens to naive T cells (PCT Publication WO 94/02156 dated February 3, 1994 at page 9, lines 5-32).

Recent studies have indicated that DCs are superior APCs as compared to other APCs such as macrophages and monocytes. First, the potent accessory cell function of DCs provides for an antigen presentation system for virtually any antigenic epitopes which T and B cells are capable of recognizing through their specific receptors. For example, Engleman et al. demonstrate that human DCs can present both complex protein antigens and small peptides to CD4<sup>+</sup> T cells as well as to CD8<sup>+</sup> CTL (PCT Publication WO 94/02156 dated February 3, 1994, Example 7, from page 29, line 10 to page 34, line 16). Engleman et al. also show that the *in vitro* priming effect of DCs does not require the addition of exogenous lymphokines, indicating that DCs produce all of the necessary signals in antigen presentation leading to the activation of T cells (PCT Publication WO 94/02156 dated February 3, 1994, from page 32, line 36 to page 33, line 2). More importantly, DCs can induce a primary CD4<sup>+</sup> T cell-mediated proliferative response when similarly prepared monocytes can not induce such a response (PCT Publication WO 94/02156 dated February 3, 1994 at page 31, lines 23-30). Similarly, when DCs and monocytes were compared for their ability to present antigens for re-activating secondary T cell response, it was observed that DCs were capable of stimulating a stronger response than monocytes (PCT Publication WO 94/02156 dated February 3, 1994 at page 32, lines 12-16).

### 2.3. CHEMOKINES

Chemokines, or chemoattractant cytokines, are a subgroup of immune factors



that have been shown to mediate chemotactic and other pro-inflammatory phenomena (see, Schall, 1991, *Cytokine* 3:165-183). Chemokines are small molecules of approximately 70-80 residues in length and can generally be divided into two subgroups,  $\alpha$  which have two N-terminal cysteines separated by a single amino acid (CxC) and  $\beta$  which have two adjacent cysteines at the N terminus (CC). RANTES, MIP-1 $\alpha$  and MIP-1 $\beta$  are members of the  $\beta$  subgroup (reviewed by Horuk, R., 1994, *Trends Pharmacol. Sci.* 15:159-165; Murphy, P.M., 1994, *Annu. Rev. Immunol.* 12:593-633; Baggiolini et al. *Annu. Rev. Immunol.* 1997, 15:675-705 ).

MCP-1 has been shown to attract monocytes but not neutrophils. MCP-1, MCP-2, and MCP-3 share a pyroglutamate proline NH<sub>2</sub>-terminal motif and are structurally closely related to each other and to eotaxin (56% to 71% amino acid sequence identity). MCP-1, MCP-2, and MCP-3 attract monocytes, CD4<sup>+</sup> and CD8<sup>+</sup> T lymphocytes (Loetscher et al. *FAESB J.* 1994, 8:1055-60), as well as basophil leukocytes. MCP-2, MCP-3, and MCP-4 (but not MCP-1) attracts eosinophil leukocytes. All four MCPs attract activated T lymphocytes, natural killer (NK) cells, and dendritic cells (see Baggiolini et al. *Annu. Rev. Immunol.* 1997, 15:675-705).

Eotaxin acts on eosinophils and is inactive on neutrophils and monocytes, but has weak-to-moderate chemotactic activity toward IL-2-conditioned T lymphocytes (see Baggiolini et al. *Annu. Rev. Immunol.* 1997, 15:675-705). Due to its preferential, powerful action on eosinophils and its occurrence in different species, eotaxin is considered to be an important chemokine in the pathophysiology of allergic conditions and asthma (See Baggiolini et al. *Annu. Rev. Immunol.* 1997, 15:675-705).

IP10 is a CXC chemokine attracts human monocytes, T lymphocytes, and NK cells, and Mig attracts tumor-infiltrating T lymphocytes. It has been suggested that IP10 and Mig may also be involved in the regulation of lymphocyte recruitment and the formation of the lymphoid infiltrates observed in autoimmune inflammatory lesions, delayed-type hypersensitivity, some viral infections, and certain tumors (Baggiolini et al. *Annu. Rev. Immunol.* 1997, 15:675-705).

SDF-1 (stromal cell-derived factor 1), including SDF-1 and SDF-1 $\beta$  stimulates the proliferation of B cell progenitors, and attracts mature dendritic cells (Finkel et al. *Immunobiology* 1998, 198:490-500). Synthetic human SDF-1 stimulates monocytes, neutrophils, and peripheral blood lymphocytes, as is indicated by [Ca<sup>2+</sup>]<sub>i</sub> changes and chemotaxis. SDF-1 is also a powerful HIV-suppressive factor (See Baggiolini et al.

*Annu. Rev. Immunol.* 1997, 15:675-705).

The amino terminus of the  $\beta$  chemokines RANTES, MCP-1, and MCP-3 has been implicated in the mediation of cell migration and inflammation induced by these chemokines. This involvement is suggested by the observation that the deletion of the amino terminal 8 residues of MCP-1, amino terminal 9 residues of MCP-3, and amino terminal 8 residues of RANTES and the addition of a methionine to the amino terminus of RANTES, antagonize the chemotaxis, calcium mobilization and/or enzyme release stimulated by their native counterparts (Gong et al., 1996, *J. Biol. Chem.* 271:10521-10527; Proudfoot et al., 1996 *J. Biol. Chem.* 271:2599-2603). Additionally,  $\alpha$  chemokine-like chemotactic activity has been introduced into MCP-1 via a double mutation of Tyr 28 and Arg 30 to leucine and valine, respectively, indicating that internal regions of this protein also play a role in regulating chemotactic activity (Beall et al., 1992, *J. Biol. Chem.* 267:3455-3459).

The monomeric forms of all chemokines characterized thus far share significant structural homology, although the quaternary structures of  $\alpha$  and  $\beta$  groups are distinct. While the monomeric structures of the  $\beta$  and  $\alpha$  chemokines are very similar, the dimeric structures of the two groups are completely different. An additional chemokine, lymphotactin, which has only one N terminal cysteine has also been identified and may represent an additional subgroup ( $\gamma$ ) of chemokines (Yoshida et al., 1995, *FEBS Lett.* 360:155-159; and Kelner et al., 1994, *Science* 266:1395-1399).

Receptors for chemokines belong to the large family of G-protein coupled, 7 transmembrane domain receptors (GCR's) (See, reviews by Horuk, R., 1994, *Trends Pharmacol. Sci.* 15:159-165; and Murphy, P.M., 1994, *Annu. Rev. Immunol.* 12:593-633). Competition binding and cross-desensitization studies have shown that chemokine receptors exhibit considerable promiscuity in ligand binding. Examples demonstrating the promiscuity among  $\beta$  chemokine receptors include: CCR-1, which binds RANTES and MIP-1 $\alpha$  (Neote et al., 1993, *Cell* 72:415-425), CCR-4, which binds RANTES, MIP-1 $\alpha$ , and MCP-1 (Power et al., 1995, *J. Biol. Chem.* 270:19495-19500), and CCR-5, which binds RANTES, MIP-1 $\alpha$ , and MIP-1 $\beta$  (Alkhatib et al., 1996, *Science* 272:1955-1958 and Dragic et al., 1996, *Nature* 381:667-674). Erythrocytes possess a receptor (known as the Duffy antigen) which binds both  $\alpha$  and  $\beta$  chemokines (Horuk et al., 1994, *J. Biol. Chem.* 269:17730-17733; Neote et al., 1994, *Blood* 84:44-52; and Neote et al., 1993, *J. Biol. Chem.* 268:12247-12249). Thus the sequence and

structural homologies evident among chemokines and their receptors allow some overlap in receptor-ligand interactions.

Godiska et al. identified and described the nucleic acid and amino acid sequences of an additional  $\beta$  chemokine designated macrophage derived chemokine (MDC) (PCT Publication WO 96/40923 dated December 19, 1996, and 1997, *J. Exp. Med.* 185:1595-1604). PCT publication WO 96/40923 further provides materials and methods for the recombinant production of the chemokine, the purified and isolated chemokine protein, and polypeptide analogues thereof. The PCT publication WO 96/40923 does not disclose that the human MDC has chemotactic activity upon DC. While Godiska et al. (1997, *J. Exp. Med.* 185:1595-1604) showed that, in a microchamber migration assay, monocyte-derived DC migrated toward the human MDC, the reference fails to teach that MDC can enhance an immune response to an antigen *in vivo*.

Chang et al. (1997, *J. Biol. Chem.* 272(40):25229-25237), isolated a stimulated T cell chemotactic protein (STCP-1) from an activated macrophage cDNA library. The nucleotide sequence of the STCP-1 is identical to that of the MDC isolated by Godiska et al. (PCT Publication WO 96/40923 dated December 19, 1996, and 1997, *J. Exp. Med.* 185:1595-1604). However, unlike the results observed by Godiska et al. (1997, *J. Exp. Med.* 185:1595-1604), Chang et al. (1997, *J. Biol. Chem.* 272(40):25229-25237) showed that although the STCP-1 acted as a mild chemoattractant for primary activated T lymphocytes and a potent chemoattractant for chronically activated T lymphocytes, the STCP-1 has no chemoattractant activity for monocytes, neutrophils, eosinophils and resting T lymphocytes. Chang et al. further showed that the STCP-1 does not induce  $\text{Ca}^{2+}$  mobilization in monocytes, dendritic cells, neutrophils, eosinophils, lipopolysaccharide-activated B lymphocytes, and freshly isolated resting T lymphocytes.

## 2.4. HIV VACCINES

Human immunodeficiency virus (HIV) induces a persistent and progressive infection leading, in the vast majority of cases, to the development of the acquired immunodeficiency syndrome (AIDS) (Barre-Sinoussi et al., 1983, *Science* 220:868-870; Gallo et al., 1984, *Science* 224:500-503). The HIV envelope surface glycoproteins are

synthesized as a single 160 kilodalton precursor protein which is cleaved by a cellular protease during viral budding into two glycoproteins, gp41 and gp120. gp41 is a transmembrane glycoprotein and gp120 is an extracellular glycoprotein which remains non-covalently associated with gp41, possibly in a trimeric or multimeric form (Hammerskjold, M. and Rekosh, D., 1989, *Biochem. Biophys. Acta* 989:269-280). The V3 loop of gp120 is the major determinant of sensitivity to chemokine inhibition of infection or replication (Cocchi et al., 1996, *Nature Medicine* 2:1244-1247; and Oravecz et al., 1996, *J. Immunol.* 157:1329-1332).

Although considerable effort is being put into the design of effective therapeutics, currently no curative anti-retroviral drugs against AIDS exist. The HIV-1 envelope proteins (gp160, gp120, gp41) have been shown to be the major antigens for neutralizing anti-HIV antibodies present in AIDS patients (Barin et al., 1985, *Science* 228:1094-1096). Thus far, therefore, these proteins seem to be the most promising candidates to act as antigens for anti-HIV vaccine development. Several groups have begun to use various portions of gp160, gp120, and/or gp41 as immunogenic targets for the host immune system (see, for example, Ivanoff et al., U.S. Pat. No. 5,141,867; Saith et al., PCT publication WO 92/22654; Shafferman, A., PCT publication WO 91/09872; Formoso et al., PCT publication WO 90/07119). Therefore, methods to increase the efficacy of vaccines against HIV, especially vaccines using gp120 as the antigen, are needed.

Additionally a novel vaccine technology, designated genetic vaccination, nucleic acid vaccination or DNA vaccination, has been explored to induce immune responses *in vivo*. Injection of cDNA expression cassettes results in *in vivo* expression of the encoded proteins (Dubensky et al., 1984, *Proc. Natl. Acad. Sci. USA* 81:7529-7533; Raz et al., 1993, *Proc. Natl. Acad. Sci. USA* 90:4523; Wolff et al., 1990, *Science* 247:1465-1468), with the concomitant development of specific cellular and humoral immune responses directed against the encoded antigen(s) (Wang et al., 1995, *Hum. Gene Ther.* 6:407-418; Ulmer et al., 1993, *Science* 259:1745-1749; Tang et al., 1992, *Nature* 356:152-154; Michel et al., 1995, *Proc. Natl. Acad. Sci. USA* 92:5307-5311; and Lowrie et al., 1994, *Vaccine* 12:1537-1540). Humoral and cellular responses have been induced to HIV-1 and SIV antigens through various applications of this technology in macaques (Wang et al., 1995, *Virology* 221:102-112; Wang et al., 1993, *Proc. Natl. Acad. Sci. USA* 90:4156-4160; and Boyer et al., 1996, *J. Med.*

*Primatol.* 25:242-250) as well as mice (Wang et al., 1995, *Virology* 221:102-112; Lu et al., 1995, *Virology* 209:147-154; Haynes et al., 1994, *AIDS Res. Hum. Retroviruses* 10 (Suppl. 2):S43-S45; Okuda et al., 1995, *AIDS Res. Hum. Retroviruses* 11:933-943).

Recently, Lekutis et al. (1997, *J. Immunol.* 158:4471-4477), assessed the TH cell response elicited by an HIV-1 gp120 DNA vaccine in rhesus monkeys by isolation of gp120-specific, MHC class II-restricted CD4<sup>+</sup> T cell lines from the vaccinated animals. Lekutis et al. showed that the isolated cell lines proliferated in response to APC in the presence of recombinant gp120, as well as to APC expressing HIV encoded env protein. Lekutis et al. further showed that these cell lines responded to env by secreting IFN- $\gamma$  and IFN- $\alpha$  without appreciable IL-4 production. These results demonstrate that the animals exhibited a cellular immune response to the DNA vaccine.

Boyer et al. (1997, *Nature Medicine* 3:625-532), inoculated chimpanzees with an HIV-1 DNA vaccine encoding env, rev, and gag/pol, and found that the immunized animals developed specific cellular and humoral immune responses to these proteins. After challenging the immunized animals with a heterologous chimpanzee titrated stock of HIV-1 SF2, Boyer et al. further found, using a Reverse Transcriptase-Polymerase Chain Reaction (RT-PCR) assay, that those animals vaccinated with the DNA vaccine were protected against infection whereas the control animals were not so protected.

Kim et al., (1997 *J. Immunol.* 158:816-826), investigated the role of co-delivery of genes for IL-12 and GM-CSF along with DNA vaccine formulation for HIV-1 antigens env and gag/pol in mice. Kim et al. observed a dramatic increase in specific CTL response from the mice immunized with the HIV-1 DNA vaccine and IL-12. Kim et al. also observed that the co-delivery of IL-12 genes resulted in the reduction of specific antibody response, whereas the codelivery of GM-CSF genes resulted in the enhancement of specific antibody response. Kim et al. further observed that co-delivery of IL-12 gene with a HIV DNA vaccine results in splenomegaly (Kim et al. 1997, *J. Immunol.*, 158:816-826), which has been shown in mice to have toxic effects such as weight reduction or even death (Eng et al., 1995, *J. Exp. Med.* 181:1893; Stevensen et al., 1995, *J. Immunol.* 155:2545; and Orange et al., 1995, *J. Exp. Med.* 181:901).

Notwithstanding the recent developments of the HIV DNA vaccine, there still



exists a need for a method to enhance the efficacy of a vaccine, especially an HIV DNA vaccine. For instance, for efficacious vaccine against HIV-1 one preferably induces both cellular and humoral immune responses to control the infection (Boyer et al., 1997, *Nature Medicine* 3:625-532). The induction of both cellular and humoral immune response by the Berjer et al. method is still quite low because only one of the three immunized chimpanzees developed both cellular and humoral responses. Similarly, although co-delivery of an IL-12 encoding gene with a HIV DNA vaccine, as described in Kim et al. (1997, *J. Immun.* 158:816-826), may have enhanced the cellular immune response, this co-delivery also decreased the humoral response.

Citation of a reference hereinabove shall not be construed as an admission that such reference is prior art to the present invention.

### 3. SUMMARY OF THE INVENTION. SUMMARY OF THE INVENTION. . SUMMARY OF THE INVENTION

The present invention is based upon the ability of chemokines, such as MDC, Rantes, MIP-1d, MIP-1B, and I-309, to enhance the immune response to an antigen, particularly a vaccine. Accordingly, in a first aspect, the present invention provides a method for enhancing the efficacy of a vaccine, which method comprises administration to a subject of one or more purified chemokines, or biologically active fragments, analogues or derivatives thereof, either concurrently with one or more purified antigens against which an immune response is desired or within a time period either before or after administration of the antigens such that the immune response against the antigens is enhanced.

In a second aspect, the present invention provides a method to enhance the efficacy of a vaccine, which method comprises administration to a subject of a first set of one or more purified nucleic acids comprising one or more nucleotide sequences encoding one or more chemokines, or fragments, derivatives, analogues, and/or truncation isoforms thereof, and a second purified nucleic acid comprising a nucleotide sequence encoding one or more antigens against which an immune response is desired, such that, the one or more chemokine(s) and the antigen(s) are expressed in a coordinated manner upon introduction into a suitable cell. Alternatively, the nucleotide sequences encoding one or more chemokines, or



fragments, derivatives, and/or analogues thereof, and the antigens against which an immune response is desired are present on the same nucleic acid.

In a preferred embodiment, the invention provides a method to enhance the efficacy of an HIV vaccine.

In yet another aspect, the present invention provides a composition comprising an immunogenic amount of one or more purified antigens, an amount of one or more purified chemokines, or a fragments, derivatives, analogues and/or truncation isoforms thereof, effective to enhance the immune response to the antigen. In another aspect, the present invention provides a composition comprising a first set of one or more purified nucleic acids comprising one or more nucleotide sequences encoding one or more chemokines, fragments, derivatives analogues and or truncation isoforms thereof, and a second set of purified nucleic acids comprising one or more nucleotide sequences encoding one or more antigens against which an immune response is desired, such that, the chemokine(s) and the antigen are expressed in a coordinated manner upon introduction into a suitable cell. In a preferred embodiment, the antigen is an HIV antigen. In another preferred embodiment, the chemokine is selected from the group consisting of: Macrophage-derived chemokine, Monocyte chemotactic protein 1, Monocyte chemotactic protein 2, Monocyte chemotactic protein 3, Monocyte chemotactic protein 4, activated macrophage specific chemokine 1, Macrophage inflammatory protein 1 alpha, Macrophage inflammatory protein 1 beta, Macrophage inflammatory protein 1 gamma, Macrophage inflammatory protein 1 delta, Macrophage inflammatory protein 2 alpha, Macrophage inflammatory protein 3 alpha, Macrophage inflammatory protein 3 beta, Regulated upon activation, normal T cell expressed and secreted (and its variants), I-309, EBI1-ligand chemokine, Pulmonary and activation regulated chemokine, Liver and activation-regulated chemokine, Thymus and activation regulated chemokine, Eotaxin (and variants), Human CC chemokine 1, Human CC chemokine 2, Human CC chemokine 3, IL-10-inducible chemokine, liver-expressed chemokine, 6Ckine, Exodus 1, Exodus 2, Exodus 3, thymus-expressed chemokine, Secondary Lymphoid tissue chemokine, Lymphocyte and Monocyte chemoattractant; Monotactin, Activation-induced, chemokine-related molecule, Myeloid progenitor inhibitory factor-1, Myeloid progenitor inhibitory factor-2, Stromal cell-derived factor 1 alpha, Stromal cell-derived factor 1 beta, B-cell-attracting chemokine 1, HuMIG, H174, Interferon-stimulated T-cell alpha

chemoattractant, Interleukin-8, IP-10, platelet factor 4, growth-regulated gene-alpha, growth-regulated gene-beta, growth-regulated gene-gamma, Neutrophil-activating protein 2, ENA-78, granulocyte chemotactic protein 2, LYMPHOTACTIN, and Fractalkine/neurotactin.

#### 4. DESCRIPTION OF FIGURES

Figures 1A and 1B. The nucleotide and amino acid sequences of MDC. 1A depicts the nucleotide sequence of MDC (SEQ ID NO:1), with the coding region indicated by the appearance of the amino acid sequence in the line below; and 1B depicts the amino acid of MDC (SEQ ID NO:2) from GenBank accession no. U83171 (Godiska et al., 1997, *J. Exp. Med.* 185:1595-1604).

#### 5. DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to a method for enhancing the efficacy of a vaccine in a subject comprising administering to the subject one or more purified antigens in conjunction with one or more purified chemokines, or more purified fragments, derivatives or analogues and/or truncation isoforms thereof.

While any chemokine may be employed according to the present invention, the chemokine is preferably selected from the following table:

Chemokine Class	Chemokines	Abbreviations	Accession Number
CC Chemokines	Macrophage-derived chemokine	MDC/STCP-1	u83171; u83239
	Monocyte chemotactic protein 1	MCP-1	x14768
	Monocyte chemotactic protein 2	MCP-2	X99886
	Monocyte chemotactic protein 3	MCP-3	x72308; s57464
	Monocyte chemotactic protein 4	MCP-4	u46767
	activated macrophage specific chemokine 1	AMAC-1	Y13710
	Macrophage inflammatory protein 1 alpha	MIP-1 $\alpha$	AF043339; X03754; D90144

Chemokine Class	Chemokines	Abbreviations	Accession Number
CC Chemokines (continued)	Macrophage inflammatory protein 1 beta	MIP-1 $\beta$	j04130; d90145
	Macrophage inflammatory protein 1 gamma	MIP-1 $\gamma$	
	Macrophage inflammatory protein 1 delta	MIP-1 $\delta$	AF031587
	Macrophage inflammatory protein 2 alpha	MIP-2 $\alpha$	AF043340
	Macrophage inflammatory protein 3 alpha	MIP-3 $\alpha$	u77035
	Macrophage inflammatory protein 3 beta	MIP-3 $\beta$	u77180
	Regulated upon activation, normal T cell expressed and secreted (and its variants)	RANTES	M21211
	I-309		M57502
	EBI1-ligand chemokine	ELC	AB000887
	Pulmonary and activation regulated chemokine	PARC/DC-CK-1/MIP4	AB000221
	Liver and activation-regulated chemokine	LARC	D86955
	Thymus and activation regulated chemokine	TARC	D43767
	Eotaxin (and variants)		D49372; Z69291; Z75669; Z75668
	Human chemokine 1	HCC1; NCC2	Z49270; z49269
	Human chemokine 2	HCC2; NCC3, MIP-5, MIP-1 $\delta$	Z70292
	Human chemokine 3	HCC3	Z70293
	IL-10-inducible chemokine	HCC4	U91746
	liver-expressed chemokine.	LEC; HCC4;NCC4	AB007454
	6Ckine		AF001979
	Exodus 1		u64197
	Exodus 2		U88320
	Exodus 3		U88321
	thymus-expressed chemokine	TECK	U86358
	Secondary Lymphoid tissue chemokine	SLC	AB002409

Chemokine Class	Chemokines	Abbreviations	Accession Number
CC Chemokines (continued)	Lymphocyte and Monocyte chemoattractant; Monotactin	LMC	AF055467
	Activation-induced, chemokine-related molecule	ATAC	x86474
	Myeloid progenitor inhibitory factor-1	MPIF-1; MIP-3 or ckbeta8	u85767
	Myeloid progenitor inhibitory factor-2	MPIF-2	u85768
	Stromal cell-derived factor 1 alpha	SDF-1 $\alpha$ ; PBSF	L36034
CXC chemokines	Stromal cell-derived factor 1 beta	SDF-1 $\beta$ ; PBSF	L36033
	B-cell-attracting chemokine 1	BLC	AJ002211
	HuMIG		x72755 s60728
	H174		AF002985
	Interferon-stimulated T-cell alpha chemoattractant	I-TAC	AF030514
	Interleukin-8	IL-8	m17017; y00787
	IP-10		X02530
	platelet factor 4	PF4	M20901
	growth-regulated gene-alpha	GRO- $\alpha$	J03561
	growth-regulated gene-beta	GRO- $\beta$	M36820
	growth-regulated gene-gamma	GRO- $\gamma$	M36821
	Neutrophil-activating protein 2	NAP-2; CTAP-3	M54995; M38441
	ENA-78		L37036
	granulocyte chemotactic protein 2	GCP-2	Y08770
C-CHEMOKINES	LYMPHOTACTIN	SCM-1	D63789 D63790
CX <sub>3</sub> C-CHEMOKINES	Fractalkine/neurotactin		U91835 U84487

The present invention also relates to the use of fragments, analogues and derivatives of the foregoing chemokines, as well as truncation isoforms of such chemokines which are known in the art.

The present invention also relates to therapeutic compositions comprising one or more chemokines, nucleic acids encoding one or more chemokines, derivatives, analogues, and/or truncation isoforms thereof, and nucleic acids encoding the same, that are effective to enhance the immune response of a subject to a vaccine.

In another preferred embodiment of the invention, nucleic acids comprising

nucleotide sequences encoding one or more chemokines or fragments or derivatives, including truncation isoforms, thereof, and encoding one or more antigens against which an immune response is desired, which coding sequences are operatively linked to gene regulatory sequences capable of directing the expression of the one or more chemokines and the one or more antigens upon introduction into a suitable cell, for example, but not limited to, the cell (of a subject), are administered to a subject such that the one or more chemokines, or fragments or derivatives, including truncation isoforms, thereof, and one or more antigens, are expressed in the subject.

For clarity of disclosure, and not by way of limitation, the detailed description of the invention is divided into the subsections which follow.

#### **5.1. METHODS AND COMPOSITIONS TO ENHANCE THE EFFICACY OF A VACCINE**

The present invention provides methods for enhancing the efficacy of a vaccine in a subject, which methods comprise administering to a subject an immunogenic amount of one or more purified antigens against which an immune response is desired in the subject in conjunction with an amount of one or more purified chemokines, or fragments, derivatives, analogues and/or truncation isoforms thereof, effective to enhance the immune response against the antigen. In one aspect, the purified chemokine(s), or fragment(s), derivative(s), analogue(s) and/or truncation isoforms thereof, are administered to the subject concurrently with (e.g., in the same composition with) the purified antigen or antigens against which an immune response is desired. In another, aspect, the purified chemokine(s), or fragment(s), derivative(s), analogue(s) and/or truncation isoforms thereof, are administered either before or after the administration of one or more purified antigens against which immunity is desired in the subject, but is administered within such time that the chemokine(s) enhance the immune response to the one or more antigens. For example, but not by way of limitation, the purified chemokine(s) are administered during the time that the subject mounts an immune response against the administered one or more antigens, or, the purified MDC is administered within, for example, but not limited to, 30 minutes, 1 hour, 5 hours, 10 hours, 1 day, 2 days of (preferably, after) administration of the one or more purified antigens against which immunity is desired.

In a preferred embodiment, the present invention provides compositions comprising an immunogenic amount of one or more purified antigens and an amount of purified MDC, or one or more fragments, derivatives or analogues thereof, effective to enhance the immune response to said antigen and, preferably, the composition further comprises a pharmaceutically acceptable carrier.

A preferred chemokine for use in the methods and compositions of the present invention is any MDC protein, fragment or derivative thereof, that is capable of enhancing the efficacy of a vaccine (for example, but not limited to, as determined by the assays described in Section 5.4, *infra*). In one specific embodiment, the MDC is purified full length MDC, preferably full length MDC having the amino acid sequence of SEQ ID NO: 2 (Figure 1B). In another embodiment, the MDC is a purified protein, the amino acid sequence of which consists of amino acid numbers 2-69 of SEQ ID NO: 2 (Figure 1B). In another specific embodiment, the MDC is a purified protein, the amino acid sequence of which consists of amino acid numbers 3-69 of SEQ ID NO: 2 (Figure 1B). In still another specific embodiment, the MDC is a purified protein, the N-terminal amino acid sequence of which consists of the amino acid sequence Tyr-Gly-Ala-Asn-Met-Glu-Asp-Ser-Val-Cys-Cys-Arg-Asp-Tyr-Val-Arg-Tyr-Arg-Leu (portion of SEQ ID NO: 2). In yet another specific embodiment, the MDC is a purified protein, the N-terminal amino acid sequence of which consists of the amino acid sequence Pro-Tyr-Gly-Ala-Asn-Met-Glu-Asp-Ser-Val-Cys-Cys-Arg (portion of SEQ ID NO: 2). In yet another specific embodiment, the MDC is a purified derivative of a protein, the N-terminal amino acid sequence of which protein consists of the amino acid sequence Tyr-Gly-Ala-Asn-Met-Glu-Asp-Ser-Val-Cys-Cys-Arg-Asp-Tyr-Val-Arg-Tyr-Arg-Leu (SEQ ID NO:2), which derivative has activity to enhance the efficacy of the vaccine. In yet another specific embodiment, the MDC is a purified derivative of a protein, the N-terminal amino acid sequence of which protein consists of the amino acid sequence Pro-Tyr-Gly-Ala-Asn-Met-Glu-Asp-Ser-Val-Cys-Cys-Arg (SEQ ID NO:2), which derivative has activity to enhance the efficacy of the vaccine.

In yet another specific embodiment, the chemokine is a purified derivative of the protein, which derivative has one or more insertions of or substitutions with one or more non-classical amino acids relative to a corresponding wildtype chemokine, which derivative will enhance the efficacy of the vaccine. In yet another specific



embodiment, the chemokine is a purified derivative of the protein that has only one or more conservative substitutions in sequence relative a corresponding wildtype chemokine, which derivative will enhance the efficacy of the vaccine. The chemokines useful in the present invention may be derived from any suitable source and obtained by any method known in the art, for example but not limited to the methods described in Section 5.2 *infra*.

Preferably, the chemokine(s) are of the same species as the subject to which the vaccine is administered. In a preferred embodiment, one or more human chemokines are administered to a human subject, e.g., human MDC is administered to a human subject, alone or in combination with another chemokine.

The present invention also provides a method to enhance the efficacy of a vaccine in a subject, which method comprises administering to a subject a purified first nucleic acid comprising a nucleotide sequence encoding an antigen against which an immune response is desired in a subject and a purified second nucleic acid comprising a nucleotide sequence encoding one or more chemokines, or fragment(s), derivative(s) or analogue(s) thereof, where the expression of the encoded antigen(s) and chemokine(s), or fragment(s), derivative(s) or analogue(s) thereof, are under control of one or more appropriate gene regulatory elements (which regulatory elements can be any regulatory element known in the art, for example, but not limited to, those regulatory elements described in Section 5.2 *supra*), such that, upon introduction of said first and second nucleic acids into a suitable cell (e.g., a cell of the subject), the antigen and chemokine(s), or fragment(s), derivative(s) or analogue(s) thereof, are coordinately expressed, *i.e.*, are expressed either at the same time or within an appropriate time period (*i.e.*, sufficient for the chemokine(s) to enhance the immune response against the antigen relative to a corresponding immune response in the absence of the chemokine) and the antigen(s) are expressed in an immunogenic amount and the chemokine(s), or fragment(s), derivative(s) or analogue(s) thereof, are expressed in an amount sufficient to enhance the immune response against the antigen(s). In a specific embodiment, the nucleotide sequences encoding the chemokine(s) and the antigen are present on separate nucleic acids. In another embodiment, the nucleotide sequences encoding the chemokine(s) and the antigen(s) are present on the same nucleic acid.

The present invention also provides compositions to enhance the

efficacy of a vaccine in a subject, which compositions comprise a purified first nucleic acid comprising a nucleotide sequence encoding one or more antigen(s) and a purified second nucleic acid comprising a nucleotide sequence encoding one or more chemokines, or fragments or derivatives, including truncation isoforms, thereof, wherein the nucleotide sequences encoding the antigens and the chemokine(s) are operably linked to one or more gene regulatory elements such that, upon introduction of said first and second nucleic acids into a suitable cell (e.g., a cell of the subject), the antigen(s) and chemokine(s) are expressed in a coordinated manner and the antigen(s) are expressed in an immunogenic amount and the chemokine(s) are expressed in an amount effective to enhance the immune response against the antigen, relative to a corresponding immune response in the absence of such chemokine(s).

The present invention also provides compositions to enhance the efficacy of a vaccine in a subject, which compositions comprise a purified first set of one or more purified nucleic acids comprising one or more nucleotide sequences encoding one or more antigens and a purified second set of one or more purified nucleic acids comprising a nucleotide sequence encoding one or more chemokines, or fragments, analogues, derivatives, (including truncation isoforms) thereof, wherein the nucleotide sequence(s) encoding the antigen(s) and the chemokine(s) are operably linked to one or more gene regulatory elements such that, upon introduction of said first and second sets of nucleic acids into a suitable cell (e.g., a cell of the subject), the antigen(s) and chemokine(s) are expressed in a coordinated manner and the antigen(s) are expressed in an immunogenic amount and the chemokine(s) are expressed in an amount effective to enhance the immune response against the antigen, relative to a corresponding immune response in the absence of such chemokine(s).

The present invention also provides compositions to enhance the efficacy of a vaccine in a subject, which compositions comprise a purified nucleic acid comprising a first set of one or more nucleotide sequences encoding one or more antigens and a second set of one or more nucleotide sequence encoding one or more chemokines, or fragments, derivatives, or analogues thereof (including truncation isoforms), wherein the first and second sets of nucleotide sequences are operably linked to one or more gene regulatory elements such that, upon introduction into a suitable cell, the antigen(s) and the chemokine(s) are expressed in a coordinated manner and the antigen(s) are expressed in an immunogenic amount and the chemokine(s) are

expressed in an amount effective to enhance the immune response against the antigen(s).

Any nucleic acid comprising a nucleotide sequence encoding one or more chemokine proteins, or fragments or derivatives, thereof (including truncation isoforms), that are capable of enhancing the immune response to the antigen (for example, but not limited to, as determined by any of the assays described in Section 5.2., *infra*) can be used in the methods and compositions of the present invention.

In a preferred embodiment, the nucleotide sequence encodes MDC. In another embodiment, the MDC-encoding nucleotide consists of the nucleotide sequence of SEQ ID NO:1 (Figure 1A). In another specific embodiment, the method or composition of the invention uses a nucleic acid encoding an MDC derivative having deletional, insertional or substitutional mutations and combination thereof, which derivative has activity to enhance the immune response against an antigen in a subject.

Such compositions of nucleic acids encoding an antigen are often referred to as DNA vaccines.

Such DNA vaccines are produced by any method known in the art for constructing an expression plasmid vector containing the nucleotide sequences of the antigen(s) and/or chemokine(s) to be expressed which vector is suitable for expression of the encoded proteins in the subject or in cells recombinant for the expression vector, which cells are to be provided to the subject. Such expression vectors may contain various promoters, terminators and polyadenylation coding regions to control the expression of the encoded protein.

The DNA vaccine can be administered by any method known in the art for administration of DNA. The DNA vaccine may be delivered either directly, in which case the subject is directly exposed to the DNA vaccine such that the DNA enters and is expressed in cells of the subject, or indirectly, in which case, the DNA vaccine is first introduced into suitable cells by any method known in the art *in vitro*, then the cells containing the DNA vaccine are transplanted into the subject.

In a specific embodiment, the DNA vaccine is directly administered *in vivo*, where it is expressed to produce the encoded antigens and chemokine(s). This can be accomplished by any of numerous methods known in the art, e.g., by constructing it as part of an appropriate nucleic acid expression vector and administering it so that it becomes intracellular, e.g., by infection using a defective or attenuated retroviral or

other viral vector (see U.S. Patent No. 4,980,286), or by direct injection of naked DNA, or by use of microparticle bombardment (e.g., a gene gun; Biolistic, Dupont), or coating with lipids or cell-surface receptors or transfecting agents, encapsulation in liposomes, microparticles, or microcapsules, or by administering it in linkage to a peptide which is known to enter the nucleus, by administering it in linkage to a ligand subject to receptor-mediated endocytosis (see e.g., Wu and Wu, *J. Biol. Chem.* 262:4429-4432 (1987)) (which can be used to target cell types specifically expressing the receptors), etc. In another embodiment, a nucleic acid-ligand complex can be formed in which the ligand comprises a fusogenic viral peptide to disrupt endosomes, allowing the nucleic acid to avoid lysosomal degradation. In a preferred embodiment, the nucleic acid of a DNA vaccine is injected into the muscle of the subject to be immunized.

Another approach is to introduce the nucleic acid of the DNA vaccine into a cell prior to administration *in vivo* of the resulting recombinant cell. Such introduction can be carried out by any method known in the art, including but not limited to transfection, electroporation, microinjection, infection with a viral or bacteriophage vector containing the nucleic acid sequences, cell fusion, chromosome-mediated gene transfer, microcell-mediated gene transfer, spheroplast fusion, etc. Numerous techniques are known in the art for the introduction of foreign nucleic acid into cells (see e.g., Loeffler and Behr, *Meth. Enzymol.* 217:599-618 (1993); Cohen et al., *Meth. Enzymol.* 217:618-644 (1993); Cline, *Pharmac. Ther.* 29:69-92 (1985)) and may be used in accordance with the present invention. Usually, the method of transfer includes the transfer of a selectable marker to the cells. The cells are then placed under selection to isolate those cells that have taken up and are expressing the transferred gene.

Cells into which a DNA vaccine can be introduced for purposes of immunization encompass any desired, available cell type, and include but are not limited to epithelial cells, endothelial cells, keratinocytes, fibroblasts, muscle cells, hepatocytes; blood cells such as T lymphocytes, B lymphocytes, monocytes, macrophages, neutrophils, eosinophils, megakaryocytes, granulocytes; various stem or progenitor cells, in particular hematopoietic stem or progenitor cells, e.g., as obtained from bone marrow, umbilical cord blood, peripheral blood, fetal liver, etc.

The resulting recombinant cells can be delivered to a subject by various

methods known in the art. In a preferred embodiment, the recombinant cells are injected, e.g., subcutaneously. In another embodiment, recombinant skin cells may be applied as a skin graft onto the patient. Recombinant blood cells (e.g., hematopoietic stem or progenitor cells) are preferably administered intravenously. The cells can also be encapsulated in a suitable vehicle and then implanted in the subject (see, e.g., Dionne et al. PCT Publication WO 92/19195, dated November 12, 1992). The amount of cells envisioned for use depends on the desired effect, subject state, etc., and can be determined by one skilled in the art.

By way of example, and not by way of limitation a DNA vaccine may be generated as described by Lekutis et al. for an HIV DNA vaccine (1997, *J. Immunol.* 158:4471-4477). Briefly, an expression vector is constructed with the promoter, enhancer and intron A of human cytomegalovirus (CMV) and the termination and polyadenylation sequences of bovine growth hormone in a plasmid backbone. Additionally, the nucleotide sequence for signal sequence of tissue plasminogen activator is either substituted for the signal sequence of the antigen, if the antigen has a signal sequence or is added onto the amino-terminus of the antigen, thereby eliminating the dependence on viral proteins for expression (e.g., in the case of gp120 expression, rev and env proteins are required unless the HIV-1 signal sequence is so substituted). The resulting formulation is then injected intra-muscularly.

Further examples of DNA vaccines are set forth in Boyer et al. (1996, *J. Med. Primatol.*, 25:242-250), which describes the construction of a plasmid encoding the HIV-1 gp160 envelope glycoprotein as well as the rev-tax region cloned into pMAMneoBlue vector (Clontech, Inc., Palo Alto, CA), and a vector encoding the envelope glycoprotein and rev from HIV-1 strain MN under the control of the CMV promoter. Another vector which can be used in the present invention is as described in Boyer et al. (1997, *Nature Medicine* 3:526-532) and contains expression cassettes encoding the envelope and Rev proteins of HIV-1 strain MN, and encoding the Gag/Pol proteins of HIV-1 strain IIIB.

For the practice of the present invention, the nucleotide sequence for the one or more chemokines, or fragments, derivatives, or analogues thereof, can either be incorporated into the same expression vector containing the nucleotide sequence encoding the antigen in such a manner that the chemokine(s) are expressed. Alternatively, the nucleotide sequence encoding the chemokine(s), or fragment(s),



derivative(s) or analogue(s) thereof, can be cloned into a separate expression vector (e.g., as described above for the expression vector containing the sequences coding for antigen) and the expression vector that expresses the antigen(s) mixed with the expression vector that expresses the chemokine(s). The mixture of the two expression vectors can then be administered to the subject.

The methods and compositions of the present invention may be used as a vaccine in a subject in which immunity for the antigen(s) is desired. Such antigens can be any antigen known in the art to be useful in a vaccine formulation. The methods and compositions of the present invention can be used to enhance the efficacy of any vaccine known in the art. The vaccine of the present invention may be used to enhance an immune response to infectious agents and diseased or abnormal cells, such as but not limited to bacteria, parasites, fungi, viruses, tumors and cancers. The compositions of the invention may be used to either treat or prevent a disease or disorder amenable to treatment or prevention by generating an immune response to the antigen provided in the composition. In one preferred embodiment, the antigen(s) are proteins, fragments or derivatives, including truncation isoforms, thereof, encoded by any genes of the HIV genome including the *env*, *gag*, *pol*, *nef*, *vif*, *rev*, and *tat* genes. In a more preferred embodiment, the antigen is an HIV-associated gp120 protein.

The methods and compositions of the present invention may be used to elicit a humoral and/or a cell-mediated response against the antigen(s) of the vaccine in a subject. In one specific embodiment, the methods and compositions elicit a humoral response against the administered antigen in a subject. In another specific embodiment, the methods and compositions elicit a cell-mediated response against the administered antigen in a subject. In a preferred embodiment, the methods and compositions elicit both a humoral and a cell-mediated response.

The subjects to which the present invention is applicable may be any mammalian or vertebrate species, which include, but are not limited to, cows, horses, sheep, pigs, fowl (e.g., chickens), goats, cats, dogs, hamsters, mice and rats, monkeys, rabbits, chimpanzees, and humans. In a preferred embodiment, the subject is a human. The compositions and methods of the invention can be used to either prevent a disease or disorder, or to treat a particular disease or disorder, where an immune response against a particular antigen or antigens is effective to treat or prevent the



disease or disorder. Such diseases and disorders include, but are not limited to, viral infections, such as HIV, CMV, hepatitis, herpes virus, measles, etc, bacterial infections, fungal and parasitic infections, cancers, and any other disease or disorder amenable to treatment or prevention by eliciting an immune response against a particular antigen or antigens. In another preferred embodiment, the subject is infected or at risk of being infected with HIV virus.

In another preferred embodiment the invention provides methods and compositions to enhance the efficacy of an HIV vaccine, such a vaccine can be administered to either prevent or treat HIV.

## 5.2. CHEMOKINE GENES AND PROTEINS

Chemokine proteins and nucleic acids can be obtained by any method known in the art. Chemokine nucleotide and amino acid sequences are available in public databases such as Genbank and are also published in various references known to those of skill in the art. The gene bank accession numbers for the preferred chemokines of the present invention are provided in Table I, in Section 5 above. The ensuing discussion uses MDC by way of example, but applies equally to other chemokines as well.

The MDC nucleotide and amino acid sequences for, *inter alia*, human, are available in the public databases (e.g. Genbank accession No. U83171) also published in Godiska et al., 1997, *J. Exp. Med.* 185:1595-1604. The nucleotide sequence and the amino acid sequence for the human MDC are provided in Figures 1A and B (SEQ ID NOS:1 and 2, respectively).

Chemokines used herein include, but are not limited to, chemokines from mice, hamsters, dogs, cats, monkeys, rabbits, chimpanzees, and human. In one preferred embodiment, the chemokine is of human origin.

Any vertebrate cell potentially can serve as the nucleic acid source for the isolation of chemokine nucleic acids. The nucleic acid sequences encoding the chemokine(s) can be isolated from vertebrate, mammalian, human, porcine, bovine, feline, avian, equine, canine, as well as additional primate sources, etc. The DNA may be obtained by standard procedures known in the art from cloned DNA (e.g., a

DNA "library"), by chemical synthesis, by cDNA cloning, or by the cloning of genomic DNA, or fragments thereof, purified from the desired cell (see, for example, Sambrook et al., 1989, *Molecular Cloning, A Laboratory Manual*, 2d Ed., Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York; Glover, D.M. (ed.), 1985, *DNA Cloning: A Practical Approach*, MRL Press, Ltd., Oxford, U.K. Vol. I, II.) Clones derived from genomic DNA may contain regulatory and intron DNA regions in addition to coding regions; clones derived from cDNA will contain only exon sequences. Whatever the source, the gene should be molecularly cloned into a suitable vector for propagation of the gene.

In the molecular cloning of the gene from cDNA, cDNA is generated from totally cellular RNA or mRNA by methods that are well known in the art. The gene may also be obtained from genomic DNA, where DNA fragments are generated (e.g. using restriction enzymes or by mechanical shearing), some of which will encode the desired gene. The linear DNA fragments can then be separated according to size by standard techniques, including but not limited to, agarose and polyacrylamide gel electrophoresis and column chromatography.

Once the DNA fragments are generated, identification of the specific DNA fragment containing all or a portion of the chemokine gene may be accomplished in a number of ways.

A preferred method for isolating a chemokine gene is by the polymerase chain reaction (PCR), which can be used to amplify the desired chemokine sequence in a genomic or cDNA library or from genomic DNA or cDNA that has not been incorporated into a library. Oligonucleotide primers which would hybridize to chemokine sequences can be used as primers in PCR.

Additionally, a portion of the chemokine (of any species) gene or its specific RNA, or a fragment thereof, can be purified (or an oligonucleotide synthesized) and labeled, the generated DNA fragments may be screened by nucleic acid hybridization to the labeled probe (Benton, W. and Davis, R., 1977, *Science* 196:180; Grunstein, M. And Hogness, D., 1975, *Proc. Natl. Acad. Sci. U.S.A.* 72:3961). Those DNA fragments with substantial homology to the probe will hybridize. Chemokine nucleic acids can be also identified and isolated by expression cloning using, for example, anti-chemokine antibodies for selection.

Alternatives to obtaining the chemokine DNA by cloning or amplification

include, but are not limited to, chemically synthesizing the gene sequence itself from the known chemokine sequence or making cDNA to the mRNA which encodes the chemokine protein. Other methods are possible and within the scope of the invention. Once a clone has been obtained, its identity can be confirmed by nucleic acid sequencing (by any method well known in the art) and comparison to known chemokine sequences. DNA sequence analysis can be performed by any techniques known in the art, including but not limited to the method of Maxam and Gilbert (1980, *Meth. Enzymol.* 65:499-560), the Sanger dideoxy method (Sanger, F., et al., 1977, *Proc. Natl. Acad. Sci. U.S.A.* 74:5463), the use of T7 DNA polymerase (Tabor and Richardson, U.S. Patent No. 4,795,699), use of an automated DNA sequenator (e.g., Applied Biosystems, Foster City, CA) or the method described in PCT Publication WO 97/ 15690.

Nucleic acids which are hybridizable to a chemokine nucleic acid, or to a nucleic acid encoding a chemokine derivative can be isolated, by nucleic acid hybridization under conditions of low, high, or moderate stringency (see also Shilo and Weinberg, 1981, *Proc. Natl. Acad. Sci. USA* 78:6789-6792). For example, the nucleic acid of SEQ ID No: 1 is hybridizable to an MDC nucleic acid.

Chemokine proteins and derivatives, analogs and fragments of chemokine proteins can be obtained by any method known in the art, including but not limited to recombinant expression methods, purification from natural sources, and chemical synthesis.

For example, chemokines can be obtained by recombinant protein expression techniques. For recombinant expression, the chemokine gene or portion thereof is inserted into an appropriate cloning vector for expression in a particular host cell. A large number of vector-host systems known in the art may be used. Possible vectors include, but are not limited to, plasmids or modified viruses, but the vector system must be compatible with the host cell used. Such vectors include, but are not limited to, bacteriophages such as lambda derivatives, or plasmids such as pBR322 or pUC plasmid derivatives or the Bluescript vector (Stratagene). The insertion into a cloning vector can, for example, be accomplished by ligating the DNA fragment into a cloning vector which has complementary cohesive termini. However, if the complementary restriction sites used to fragment the DNA are not present in the cloning vector, the ends of the DNA molecules may be enzymatically modified. Alternatively, any site

desired may be produced by ligating nucleotide sequences (linkers) onto the DNA termini; these ligated linkers may comprise specific chemically synthesized oligonucleotides encoding restriction endonuclease recognition sequences. In an alternative method, the cleaved vector and chemokine gene may be modified by homopolymeric tailing. Recombinant molecules can be introduced into host cells via transformation, transfection, infection, electroporation, etc., so that many copies of the gene sequence are generated.

In an alternative method, the desired gene may be identified and isolated after insertion into a suitable cloning vector in a "shot gun" approach. Enrichment for the desired gene, for example, by size fractionation, can be done before insertion into the cloning vector.

In specific embodiments, transformation of host cells with recombinant DNA molecules that incorporate the isolated chemokine gene, cDNA, or synthesized DNA sequence enables generation of multiple copies of the gene. Thus, the gene may be obtained in large quantities by growing transformants, isolating the recombinant DNA molecules from the transformants and, when necessary, retrieving the inserted gene from the isolated recombinant DNA.

The nucleotide sequence coding for a chemokine protein or a functionally active analog or fragment or other derivative thereof, can be inserted into an appropriate expression vector, *i.e.*, a vector which contains the necessary elements for the transcription and translation of the inserted protein-coding sequence. The necessary transcriptional and translational signals can also be supplied by the native chemokine gene and/or its flanking regions. A variety of host-vector systems may be utilized to express the protein-coding sequence. These include but are not limited to mammalian cell systems infected with virus (e.g., vaccinia virus, adenovirus, etc.); insect cell systems infected with virus (e.g., baculovirus); microorganisms such as yeast containing yeast vectors, or bacteria transformed with bacteriophage, DNA, plasmid DNA, or cosmid DNA. The expression elements of vectors vary in their strengths and specificities. Depending on the host-vector system utilized, any one of a number of suitable transcription and translation elements may be used.

Any of the methods previously described for the insertion of DNA fragments into a vector may be used to construct expression vectors containing a chimeric gene consisting of appropriate transcriptional/translational control signals and the protein

coding sequences. These methods may include *in vitro* recombinant DNA and synthetic techniques and *in vivo* recombinants (genetic recombination). Expression of nucleic acid sequence encoding a chemokine protein or peptide fragment may be regulated by a second nucleic acid sequence so that the chemokine protein or peptide is expressed in a host transformed with the recombinant DNA molecule. For example, expression of a chemokine protein may be controlled by any promoter/enhancer element known in the art. Promoters which may be used to control chemokine expression include, but are not limited to, the SV40 early promoter region (Bernoist and Chambon, 1981, Nature 290:304-310), the promoter contained in the 3' long terminal repeat of Rous sarcoma virus (Yamamoto, et al., 1980, Cell 22:787-797), the herpes thymidine kinase promoter (Wagner et al., 1981, Proc. Natl. Acad. Sci. U.S.A. 78:1441-1445), the regulatory sequences of the metallothionein gene (Brinster et al., 1982, Nature 296:39-42); prokaryotic expression vectors such as the  $\beta$ -lactamase promoter (Villa-Kamaroff, et al., 1978, Proc. Natl. Acad. Sci. U.S.A. 75:3727-3731), or the tac promoter (DeBoer, et al., 1983, Proc. Natl. Acad. Sci. U.S.A. 80:21-25); see also "Useful proteins from recombinant bacteria" in Scientific American, 1980, 242:74-94; promoter elements from yeast or other fungi such as the Gal 4 promoter, the ADC (alcohol dehydrogenase) promoter, PGK (phosphoglycerol kinase) promoter, alkaline phosphatase promoter, and the following animal transcriptional control regions, which exhibit tissue specificity and have been utilized in transgenic animals: elastase I gene control region which is active in pancreatic acinar cells (Swift et al., 1984, Cell 38:639-646; Ornitz et al., 1986, Cold Spring Harbor Symp. Quant. Biol. 50:399-409; MacDonald, 1987, Hepatology 7:425-515); insulin gene control region which is active in pancreatic beta cells (Hanahan, 1985, Nature 315:115-122), immunoglobulin gene control region which is active in lymphoid cells (Grosschedl et al., 1984, Cell 38:647-658; Adames et al., 1985, Nature 318:533-538; Alexander et al., 1987, Mol. Cell. Biol. 7:1436-1444), mouse mammary tumor virus control region which is active in testicular, breast, lymphoid and mast cells (Leder et al., 1986, Cell 45:485-495), albumin gene control region which is active in liver (Pinkert et al., 1987, Genes and Devel. 1:268-276), alpha-fetoprotein gene control region which is active in liver (Krumlauf et al., 1985, Mol. Cell. Biol. 5:1639-1648; Hammer et al., 1987, Science 235:53-58; alpha 1-antitrypsin gene control region which is active in the liver (Kelsey et al., 1987, Genes and Devel. 1:161-171), beta-globin gene control region



which is active in myeloid cells (Mogam et al., 1985, Nature 315:338-340; Kollias et al., 1986, Cell 46:89-94), myelin basic protein gene control region which is active in oligodendrocyte cells in the brain (Readhead et al., 1987, Cell 48:703-712), myosin light chain-2 gene control region which is active in skeletal muscle (Sani, 1985, Nature 314:283-286), and gonadotropic releasing hormone gene control region which is active in the hypothalamus (Mason et al., 1986, Science 234:1372-1378).

For example, a vector can be used that comprises a promoter operably linked to an chemokine-encoding nucleic acid, one or more origins of replication, and, optionally, one or more selectable markers (e.g., an antibiotic resistance gene).

In a specific embodiment, an expression construct is made by subcloning a chemokine coding sequence into the *EcoRI* restriction site of each of the three pGEX vectors (Glutathione S-Transferase expression vectors; Smith and Johnson, 1988, Gene 7:31-40). This allows for the expression of the chemokine protein product from the subclone in the correct reading frame.

Expression vectors containing chemokine gene inserts can be identified by three general approaches: (a) nucleic acid hybridization, (b) presence or absence of "marker" gene functions, and (c) expression of inserted sequences. In the first approach, the presence of a chemokine gene inserted in an expression vector can be detected by nucleic acid hybridization using probes comprising sequences that are homologous to an inserted chemokine gene. In the second approach, the recombinant vector/host system can be identified and selected based upon the presence or absence of certain "marker" gene functions (e.g., thymidine kinase activity, resistance to antibiotics, transformation phenotype, occlusion body formation in baculovirus, etc.) caused by the insertion of a chemokine gene in the vector. For example, if the chemokine gene is inserted within the marker gene sequence of the vector, recombinants containing the chemokine insert can be identified by the absence of the marker gene function. In the third approach, recombinant expression vectors can be identified by assaying the product expressed by the recombinant. Such assays can be based, for example, on the physical or functional properties of the chemokine protein in *in vitro* assay systems, e.g., binding with anti-chemokine antibody or the chemokine's receptor.

Once a particular recombinant DNA molecule is identified and isolated, several methods known in the art may be used to propagate it. Once a suitable host

system and growth conditions are established, recombinant expression vectors can be propagated and prepared in quantity. As previously explained, the expression vectors which can be used include, but are not limited to, the following vectors or their derivatives: human or animal viruses such as vaccinia virus or adenovirus; insect viruses such as baculovirus; yeast vectors; bacteriophage vectors (e.g., lambda), and plasmid and cosmid DNA vectors, to name but a few.

In addition, a host cell strain may be chosen which modulates the expression of the inserted sequences, or modifies and processes the gene product in the specific fashion desired. Expression from certain promoters can be elevated in the presence of certain inducers; thus, expression of the genetically engineered protein may be controlled. Furthermore, different host cells have characteristic and specific mechanisms for the translational and post-translational processing and modification (e.g., glycosylation, phosphorylation of proteins. Appropriate cell lines or host systems can be chosen to ensure the desired modification and processing of the foreign protein expressed. For example, expression in a bacterial system can be used to produce an unglycosylated core protein product. Expression in yeast will produce a glycosylated product. Expression in mammalian cells can be used to ensure "native" glycosylation of a heterologous protein. Furthermore, different vector/host expression systems may effect processing reactions to different extents.

In other specific embodiments, the chemokine protein(s), fragment(s), analogue(s), or derivative(s) may be expressed as a fusion, or chimeric protein product (comprising the protein, fragment, analog, or derivative joined via a peptide bond to a heterologous protein sequence (of a different protein)). Such a chimeric product can be made by ligating the appropriate nucleic acid sequences encoding the desired amino acid sequences to each other by methods known in the art, in the proper coding frame, and expressing the chimeric product by methods commonly known in the art. Alternatively, such a chimeric product may be made by protein synthetic techniques, e.g., by use of a peptide synthesizer. In a specific embodiment, a chimeric protein containing all or a portion of the chemokine is joined via a peptide bond to all or a portion of an antigen against which immunity is desired.

Both cDNA and genomic sequences can be cloned and expressed.

The chemokine protein(s) may also be isolated and purified by standard methods including chromatography (e.g., ion exchange, affinity, and sizing column

chromatography), centrifugation, differential solubility, or by any other standard technique for the purification of proteins. The functional properties may be evaluated using any suitable assay (see Section 5.5). Alternatively, the protein can be synthesized by standard chemical methods known in the art (e.g., see Hunkapiller, M., et al., 1984, *Nature* 310:105-111). The chemokine-encoding nucleic acid sequence(s) can be mutated *in vitro* or *in vivo*, to create and/or destroy translation, initiation, and/or termination sequences, or to create variations in coding regions. Any technique for mutagenesis known in the art can be used, including, but not limited to, *in vitro* site-directed mutagenesis (Hutchinson et al., 1978, *J. Biol. Chem.* 253:6551), use of TAB linkers (Pharmacia), mutation-containing PCR primers, etc.

The experimentation involved in mutagenesis consists primarily of site-directed mutagenesis followed by phenotypic testing of the altered gene product. Some of the more commonly employed site-directed mutagenesis protocols take advantage of vectors that can provide single stranded as well as double stranded DNA, as needed. Generally, the mutagenesis protocol with such vectors is as follows. A mutagenic primer, *i.e.*, a primer complementary to the sequence to be changed, but consisting of one or a small number of altered, added, or deleted bases, is synthesized. The primer is extended *in vitro* by a DNA polymerase and, after some additional manipulations, the now double-stranded DNA is transfected into bacterial cells. Next, by a variety of methods, the desired mutated DNA is identified, and the desired protein is purified from clones containing the mutated sequence. For longer sequences, additional cloning steps are often required because long inserts (longer than 2 kilobases) are unstable in those vectors. Protocols are known to those skilled in the art and kits for site-directed mutagenesis are widely available from biotechnology supply companies, for example from Amersham Life Science, Inc. (Arlington Heights, IL) and Stratagene Cloning Systems (La Jolla, CA).

In other specific embodiments, the chemokine derivative(s) or analogue(s) may be expressed as a fusion, or chimeric protein product (comprising the protein, fragment, analogue, or derivative joined via a peptide bond to a heterologous protein sequence (of a different protein)). Such a chimeric product can be made by ligating the appropriate nucleic acid sequences encoding the desired amino acid sequences to each other by methods known in the art, in the proper coding frame, and expressing the chimeric product by methods commonly known in the art.

In addition, chemokine proteins, derivatives (including fragments and chimeric proteins), and analogues can be chemically synthesized. See, e.g., Clark-Lewis et al., 1991, *Biochem.* 30:3128-3135 and Merrifield, 1963, *J. Amer. Chem. Soc.* 85:2149-2156. For example, chemokines, derivatives and analogues can be synthesized by solid phase techniques, cleaved from the resin, and purified by preparative high performance liquid chromatography (e.g., see Creighton, 1983, *Proteins, Structures and Molecular Principles*, W.H. Freeman and Co., N.Y., pp. 50-60). Chemokines, derivatives and analogues that are proteins can also be synthesized by use of a peptide synthesizer. The composition of the synthetic peptides may be confirmed by amino acid analysis or sequencing (e.g., the Edman degradation procedure; see Creighton, 1983, *Proteins, Structures and Molecular Principles*, W.H. Freeman and Co., N.Y., pp. 34-49).

The chemokine proteins, derivatives, or analogues of the invention may be synthesized in their entirety by the sequential addition of amino acid residues or alternatively as fragment subcomponents which may be combined using techniques well known in the art, such as, for example, fragment condensation (Shin et al., 1992, *Biosci. Biotech. Biochem.* 56:404-408; Nyfeler et al., 1992, *Peptides*, Proc. 12th Amer. Pep. Soc., Smith and Rivier (eds), Leiden, pp 661-663); and Nokihara et al., 1990, *Protein Research Foundation*, Yanaihara (ed), Osaka, pp 315-320).

In a less preferred embodiment, chemokine derivatives can be obtained by proteolysis of the protein followed by purification using standard methods such as those described above (e.g., immunoaffinity purification).

In another alternate embodiment, native chemokine proteins can be purified from natural sources, by standard methods such as those described above (e.g., immunoaffinity purification).

### 5.3. COMPOSITION FORMULATIONS AND METHODS OF ADMINISTRATION

The composition formulations of the invention comprise an effective immunizing amount of an immunologically active ingredient, i.e., one or more antigens, and an amount of one or more chemokine(s), or fragment(s) or derivative thereof, effective to enhance the immune response against the antigen in a subject, and a pharmaceutically acceptable carrier or excipient. In a specific embodiment, the

chemokines are selected from the group consisting of Macrophage-derived chemokine, Monocyte chemotactic protein 1, Monocyte chemotactic protein 2, Monocyte chemotactic protein 3, Monocyte chemotactic protein 4, activated macrophage specific chemokine 1, Macrophage inflammatory protein 1 alpha, Macrophage inflammatory protein 1 beta, Macrophage inflammatory protein 1 gamma, Macrophage inflammatory protein 1 delta, Macrophage inflammatory protein 2 alpha, Macrophage inflammatory protein 3 alpha, Macrophage inflammatory protein 3 beta, Regulated upon activation, normal T cell expressed and secreted (and its variants), I-309, EBI1-ligand chemokine, Pulmonary and activation regulated chemokine, Liver and activation-regulated chemokine, Thymus and activation regulated chemokine, Eotaxin (and variants), Human CC chemokine 1, Human CC chemokine 2, Human CC chemokine 3, IL-10-inducible chemokine, liver-expressed chemokine, 6Ckine, Exodus 1, Exodus 2, Exodus 3, thymus-expressed chemokine, Secondary Lymphoid tissue chemokine, Lymphocyte and Monocyte chemoattractant; Monotactin, Activation-induced, chemokine-related molecule, Myeloid progenitor inhibitory factor-1, Myeloid progenitor inhibitory factor-2, Stromal cell-derived factor 1 alpha, Stromal cell-derived factor 1 beta, B-cell-attracting chemokine 1, HuMIG, H174, Interferon-stimulated T-cell alpha chemoattractant, Interleukin-8, IP-10, platelet factor 4, growth-regulated gene-alpha, growth-regulated gene-beta, growth-regulated gene-gamma, Neutrophil-activating protein 2, ENA-78, granulocyte chemotactic protein 2, LYMPHOTACTIN, and Fractalkine/neurotactin.

Pharmaceutically acceptable carriers or excipients are well known in the art and include but are not limited to saline, buffered saline, dextrose, water, glycerol, ethanol, sterile isotonic aqueous buffer, and combinations thereof. One example of such an acceptable carrier is a physiologically balanced culture medium containing one or more stabilizing agents such as stabilized, hydrolyzed proteins, lactose, etc. The carrier is preferably sterile. The formulation should suit the mode of administration.

In addition, if desired, the vaccine or composition preparation may also include minor amounts of auxiliary substances such as wetting or emulsifying agents, pH buffering agents, and/or adjuvants which enhance the effectiveness of the vaccine or composition. Suitable adjuvants may include, but are not limited to: mineral gels,



e.g., aluminum hydroxide; surface active substances such as lysolecithin, pluronic polyols; polyanions; peptides; oil emulsions; alum, MDP, N-acetyl-muramyl-L-threonyl-D-isoglutamine (thr-MDP), N-acetyl-nor-muramyl-L-alanyl-D-isoglutamine, and N-acetylmuramyl-L-alanyl-D-isoglutaminyl-L-alanine-2-(1'-2'-dipalmitoyl-sn-glycero-3-hydroxyphosphoryloxy)-ethylamine. The effectiveness of an adjuvant may be determined by comparing the induction of antibodies directed against a MDC-containing composition in the presence and in the absence of various adjuvants.

In instances where the recombinant antigen is a hapten, *i.e.*, a molecule that is antigenic in that it can react selectively with cognate antibodies, but not immunogenic in that it cannot elicit an immune response, the hapten may be covalently bound to a carrier or immunogenic molecule; for instance, a large protein such as serum albumin will confer immunogenicity to the hapten coupled to it. The hapten-carrier may be formulated for use as a vaccine.

The composition can be a liquid solution, suspension, emulsion, tablet, pill, capsule, sustained release formulation, or powder. Oral formulation can include standard carriers such as pharmaceutical grades of mannitol, lactose, starch, magnesium stearate, sodium saccharine, cellulose, magnesium carbonate, etc.

The chemokine(s), or fragment(s) or derivative(s) thereof, and/or the antigen(s) may be formulated into the composition as neutral or salt forms. Pharmaceutically acceptable salts include the acid addition salts (formed with free amino groups of the peptide) and which are formed with inorganic acids, such as, for example, hydrochloric or phosphoric acids, or organic acids such as acetic, oxalic, tartaric, maleic, and the like. Salts formed with free carboxyl groups may also be derived from inorganic bases, such as, for example, sodium potassium, ammonium, calcium, or ferric hydroxides, and such organic bases as isopropylamine, trimethylamine, 2-ethylamino ethanol, histidine, procaine and the like.

The vaccines of the invention may be multivalent or univalent. Multivalent vaccines are made from recombinant viruses that direct the expression of more than one antigen.

An effective dose (immunizing amount) is that amount sufficient to produce an immune response to the antigen(s) in the host to which the vaccine preparation is administered. The precise dose of the composition to be employed in the formulation will depend on the route of administration, and the nature of the subject to be

immunized, and should be decided by the practitioner according to standard clinical techniques. Effective doses of the vaccines or compositions of the present invention may also be extrapolated from dose-response curves derived from animal model test systems.

The invention also provides a pharmaceutical pack or kit comprising one or more containers comprising one or more of the ingredients of the composition formulations of the invention. Associated with such container(s) can be a notice in the form prescribed by a governmental agency regulating the manufacture, use or sale of pharmaceuticals or biological products, which notice reflects approval by the agency of manufacture, use or sale for human administration.

Generally, the ingredients are supplied either separately or mixed together in unit dosage form, for example, as a dry lyophilized powder or water free concentrate in a hermetically sealed container such as an ampoule or sachette indicating the quantity of active agent. Where the composition is administered by injection, an ampoule of sterile diluent can be provided so that the ingredients may be mixed prior to administration.

In a specific embodiment, a lyophilized immunologically active ingredient and one or more chemokine polypeptide(s) of the invention are provided in a first container; a second container comprises diluent consisting of an aqueous solution of 50% glycerin, 0.25% phenol, and an antiseptic (e.g., 0.005% brilliant green).

Many methods may be used to introduce the composition formulations of the invention; these include but are not limited to oral, intradermal, intramuscular, intraperitoneal, intravenous, subcutaneous, intranasal routes, and via scarification (scratching through the top layers of skin, e.g., using a bifurcated needle).

The DNA vaccines of the invention can be administered by any method known in the art for delivery of DNA to subject (for example, as described in Section 5.3 *supra*)

#### 5.4. DETERMINATION OF COMPOSITION EFFICACY

The activity of one or more chemokines, or a fragment, derivative or analogue thereof, to enhance immune response to an antigen can be determined by monitoring the immune response in test animals following immunization with a composition containing the chemokine(s) and an antigen and comparing the response to that following immunization with the antigen in the absence of the chemokine(s). Generation of a humoral (antibody) response and/or cell-mediated immunity, may be taken as an indication of an immune response. Test animals may include mice, hamsters, dogs, cats, monkeys, rabbits, chimpanzees, etc., and eventually human subjects. Assays for humoral and cell-mediated immunity are well known in the art.

Methods of introducing the composition may include oral, intracerebral, intradermal, intramuscular, intraperitoneal, intravenous, subcutaneous, intranasal or any other standard routes of immunization. The immune response of the test subjects can be analyzed by various approaches well known in the art, such as but not limited to: testing the reactivity of the resultant immune serum to the antigen of the chemokine-containing vaccine, as assayed by known techniques, e.g., immunosorbant assay (ELISA), immunoblots, radioimmunoprecipitations, etc.

As one example of suitable animal testing, a composition of the present invention may be tested in mice for the ability to enhance an antibody response to an antigen (using for example, but not limited to, the method as described in Section 6, *infra*) and the delayed-type hypersensitivity (DTH) response (also described in Section 6 *infra*), measured by an increase in footpad swelling after inoculation in the footpad of the test animal, as compared to the measurements in animals administered the antigen in a composition not containing chemokine. For example, as test animals BALB/c mice may be used. The test group each receives an inoculation with fixed amount of antigen and varying amount of one or more chemokines. The control group receives an inoculation of comparable amount of antigen alone.

Serum samples may be drawn from the mice after the final inoculation (for example every one or two weeks after inoculation), and serum is analyzed for antibodies against the antigen using known methods in the art, e.g., using an ELISA. DTH responses to the antigen may be measured after the final inoculation (e.g. within 1-7 days). An increase in the serum titer of antibodies recognizing the antigen and/or

an increase in footpad swelling in the animals receiving the antigen-compositions containing the chemokine(s) as compared to the serum titer of antibodies against the antigen and/or the footpad swelling in the animals receiving the antigen composition not containing the chemokine(s), indicates that the chemokine(s) enhance the immune response to antigen. An increase in the serum titer of antibodies recognizing the antigen and/or an increase in footpad swelling in the animals receiving the antigen-compositions containing the chemokines as compared to the serum titer of antibodies against the antigen and/or the footpad swelling in the animals receiving the antigen composition not containing chemokine(s), indicates that the chemokine(s) enhances the immune response to antigen. An increase in the serum titer of antibodies recognizing the antigen and/or an increase in footpad swelling in the animals receiving the antigen-compositions containing MDC as compared to the serum titer of antibodies against the antigen and/or the footpad swelling in the animals receiving the antigen composition not containing MDC, indicates that the MDC enhances the immune response to antigen. An increase in the serum titer of antibodies recognizing the antigen and/or an increase in footpad swelling in the animals receiving the antigen-compositions containing MDC as compared to the serum titer of antibodies against the antigen and/or the footpad swelling in the animals receiving the antigen composition not containing MDC, indicates that the MDC enhances the immune response to antigen.

## **6. EXAMPLE: IMMUNIZATION WITH MDC-CONTAINING COMPOSITION**

The following experiment illustrates the evaluation of whether MDC will act as an adjuvant for a protein antigen and enhance the efficacy of a vaccine. However, it will be appreciated that the description applies equally to other chemokines and combinations of chemokines.

### **6.1. MATERIALS AND METHODS**

#### **6.1.1. ANIMALS AND REAGENTS**

BALB/c mice are purchased from Harlan-Sprague-Dawley (Indianapolis, IN).

Human MDC (hMDC) was obtained from CD8<sup>+</sup> T cell clones immortalized *in vitro* prepared as previously described (Markham et al., 1983 *Int. J. Cancer* 31:413; Markham et al. 1984, *Int. J. Cancer* 33:13). One such immortalized CD8<sup>+</sup> T cell clone, F3b Clone 19, was adapted to growth in serum-free medium by the following procedure and used for further studies. F3b Clone 19 cells were grown in complete medium containing rIL-2 (16 ng/ml) at 37°C in a CO<sub>2</sub> incubator. After expanding the culture to 200 ml, the cells were pelleted and resuspended in RPMI medium containing HB101 (Irvine Scientific) supplemented with 16 ng/ml of rIL-2, 1% glutamine and 1% penicillin/streptomycin. The cells were grown to full confluence and the medium harvested by centrifugation at 670 x g for 10 minutes.

Human MDC (hMDC) was purified from F3b Clone 19 as described in Pal et al., 1997, *Science* 278:695-698. Briefly, the cell free culture supernatant from F3b Clone 19 was clarified by high speed centrifugation and fractionated by heparin affinity chromatography, taking advantage of the heparin binding characteristics of chemokines (Witt and Lander, 1994, *Current Biology* 4:394; Proost et al., 1996, *Method: A Companion to Methods in Enzymology* 10:82). Culture supernatant (1200 ml) from F3b Clone 19, grown to high cell density in serum-free medium supplemented with rIL-2 was clarified by high speed centrifugation (100,000 x g for 60 minutes at 4°C) and applied to a 5 ml HiTrap heparin affinity FPLC column (Pharmacia) equilibrated in 10 mM Tris-HCl, pH 7.6 containing 0.1 M NaCl (column buffer). The column was then washed extensively with column buffer and the bound proteins eluted from the column with 10 mM Tris-HCl, pH 7.6 containing 2.0 M NaCl at a flow rate of 0.5 to 1 ml/minute. Virtually all of the HIV suppressive activity effective against primary NSI and SI isolates and HIV-1<sub>IIIIB</sub> was recovered in the column eluate (data not shown). The heparin affinity column eluate was brought to pH 2.0 by addition of trifluoroacetic acid (TFA) and subjected to reversed phase HPLC on a PEEK C-18 column (Waters Instruments) equilibrated in H<sub>2</sub>O containing 0.1 % TFA. Proteins bound to the column were eluted with a 5 minute linear gradient of aqueous acetonitrile (0 to 35 %) containing 0.1% TFA. After 10 minutes at 35% acetonitrile, the column was further developed with a 60 minute linear gradient of 35-70% aqueous acetonitrile in TFA. The flow rate was maintained at 0.5 to 1 ml/minute. The fractions obtained were then tested for suppressor activity in the acute infectivity assay using HIV-1<sub>IIIIB</sub>. Active fractions were pooled, diluted twofold in H<sub>2</sub>O with 0.1 % TFA



and reapplied to the column. The column was then developed with a 30 minute linear aqueous acetonitrile gradient (0-60%) containing 0.1% TFA at a flow rate of 0.5 to 1 ml/minute. The fractions obtained were assayed as above. Active fractions were pooled, diluted with H<sub>2</sub>O/0.1 % TFA and fractionated under the same conditions to obtain a single protein peak. The fraction corresponding to the peak and flanking fractions were tested in the infectivity assay to verify that suppressor activity was cofractionated with the protein.

Suppressive activity against HIV-1<sub>IIIIB</sub> in the absence of cytotoxic effects consistently copurified with a single protein peak that appeared as a homogeneous 8 kDa band when analyzed by SDS-polyacrylamide gel electrophoresis. This protein was not reactive in ELISAs for RANTES, MIP-1 $\alpha$  or MIP-1 $\beta$  (R&D Systems).

Recombinant gp120 protein derived from HIV-1 IIIIB isolate is purchased from Intracel (Foster City, CA).

#### 6.1.2 IMMUNIZATION OF MICE

The hMDC and the gp120 is resuspended in a total volume of 50  $\mu$ l of phosphate-buffered saline (PBS). Mice are divided into 5 groups with 3-4 mice in each group. Groups 1-4 are inoculated with 10  $\mu$ g gp120 and 0.3  $\mu$ g, 0.1  $\mu$ g, 0.03  $\mu$ g, and 0.01  $\mu$ g of hMDC, respectively. As a control, group 5 is inoculated with 10  $\mu$ g of gp120 in the absence of hMDC. For primary inoculation, each group of mice is inoculated with 10  $\mu$ l of the hMDC and gp120 solution via footpad. Two to three weeks after the primary inoculation, each mouse is given the same does of hMDC/gp120 that is used in primary inoculation.

#### 6.1.3 ELISA ASSAY

Serum samples are collected one week after the second inoculation via tail vein bleed. gp120 serum responses are measured using standard gp120 antibody ELISA assays.

#### 6.1.4 DTH ASSAY

The delayed-type hypersensitivity (DTH) response is measured from 1-7 days after the second inoculation. A caliper is to be used to measure footpad swelling.

## 6.2. RESULTS

Mice inoculated with hMDC/gp120 are expected to have greater serum antibody and DTH responses than mice inoculated with gp120 alone. The improved responses will be reflected in either increased titers of serum antibody responses or increased footpad swelling. A dose response effect is expected - increasing the dose of hMDC used is expected to cause a corresponding improvement in the serum and DTH gp120-specific responses.

## 7. EXAMPLE: OTHER CHEMOKINES AND COMBINATIONS OF CHEMOKINES

The foregoing experiments can be repeated using other chemokines and combinations of chemokines. For example, the experiments are preferably repeated using one or more chemokines selected from the group consisting of: Macrophage-derived chemokine, Monocyte chemotactic protein 1, Monocyte chemotactic protein 2, Monocyte chemotactic protein 3, Monocyte chemotactic protein 4, activated macrophage specific chemokine 1, Macrophage inflammatory protein 1 alpha, Macrophage inflammatory protein 1 beta, Macrophage inflammatory protein 1 gamma, Macrophage inflammatory protein 1 delta, Macrophage inflammatory protein 2 alpha, Macrophage inflammatory protein 3 alpha, Macrophage inflammatory protein 3 beta, Regulated upon activation, normal T cell expressed and secreted (and its variants), I-309, EBI1-ligand chemokine, Pulmonary and activation regulated chemokine, Liver and activation-regulated chemokine, Thymus and activation regulated chemokine, Eotaxin (and variants), Human CC chemokine 1, Human CC chemokine 2, Human CC chemokine 3, IL-10-inducible chemokine, liver-expressed chemokine., 6Ckine, Exodus 1, Exodus 2, Exodus 3, thymus-expressed chemokine, Secondary Lymphoid tissue chemokine, Lymphocyte and Monocyte chemoattractant; Monotactin, Activation-induced, chemokine-related molecule, Myeloid progenitor inhibitory factor-1, Myeloid progenitor inhibitory factor-2, Stromal cell-derived factor 1 alpha, Stromal cell-derived factor 1 beta, B-cell-attracting chemokine 1, HuMIG, H174, Interferon-stimulated T-cell alpha chemoattractant, Interleukin-8, IP-10, platelet factor 4, growth-regulated gene-alpha, growth-regulated gene-beta, growth-regulated gene-gamma, Neutrophil-activating protein 2, ENA-78, granulocyte chemotactic protein 2, LYMPHOTACTIN, and Fractalkine/neurotactin.

The present invention is not to be limited in scope by the specific embodiments described herein. Indeed, various modifications of the invention in addition to those described herein will become apparent to those skilled in the art from the foregoing description. Such modifications are intended to fall within the scope of the appended claims.

Various references are cited herein, the disclosures of which are incorporated by reference in their entireties.

## THE CLAIMS:

1. A method to enhance the efficacy of a vaccine in a subject comprising administering to the subject an immunogenic amount of one or more purified antigens against which an immune response is desired in the subject and an amount of one or more chemokines, or purified fragments or derivatives thereof, effective to enhance the efficacy of said vaccine.
2. The method of claim 1, wherein the one or more chemokines are selected from a chemokine class selected from the group consisting of: CC, CXC, C-C and CX3C.
3. The method of claim 1, wherein the one or more chemokines are selected from the group consisting of: Macrophage-derived chemokine, Monocyte chemotactic protein 1, Monocyte chemotactic protein 2, Monocyte chemotactic protein 3, Monocyte chemotactic protein 4, activated macrophage specific chemokine 1, Macrophage inflammatory protein 1 alpha, Macrophage inflammatory protein 1 beta, Macrophage inflammatory protein 1 gamma, Macrophage inflammatory protein 1 delta, Macrophage inflammatory protein 2 alpha, Macrophage inflammatory protein 3 alpha, Macrophage inflammatory protein 3 beta, Regulated upon activation, normal T cell expressed and secreted (and its variants), I-309, EBI1-ligand chemokine, Pulmonary and activation regulated chemokine, Liver and activation-regulated chemokine, Thymus and activation regulated chemokine, Eotaxin (and variants), Human CC chemokine 1, Human CC chemokine 2, Human CC chemokine 3, IL-10-inducible chemokine, liver-expressed chemokine, 6Ckine, Exodus 1, Exodus 2, Exodus 3, thymus-expressed chemokine, Secondary Lymphoid tissue chemokine, Lymphocyte and Monocyte chemoattractant; Monotactin, Activation-induced, chemokine-related molecule, Myeloid progenitor inhibitory factor-1, Myeloid progenitor inhibitory factor-2, Stromal cell-derived factor 1 alpha, Stromal cell-derived factor 1 beta, B-cell-attracting chemokine 1, HuMIG, H174, Interferon-stimulated T-cell alpha chemoattractant, Interleukin-8, IP-10, platelet factor 4, growth-regulated gene-alpha, growth-

regulated gene-beta, growth-regulated gene-gamma, Neutrophil-activating protein 2, ENA-78, granulocyte chemotactic protein 2, LYMPHOTACTIN, and Fractalkine/neurotactin.

4. The method of claim 1, wherein the one or more chemokines are selected from the group consisting of: MDC, SDF-1, BLC, and MCP-1.
5. The method of claim 1 wherein the fragment(s) or derivative(s) are truncation isoforms.
6. The method of claim 1, wherein the one or more chemokines include MDC comprising the amino acid sequence of SEQ ID NO: 2.
7. The method of claim 1, wherein the one or more chemokine fragment includes an MDC fragment selected from the group consisting of amino acid numbers 2-69, 3-69, 5-69, 7-69 and 9-69 of SEQ ID NO: 2.
8. The method of claim 1, wherein the one or more chemokine fragment includes an MDC fragment selected from the group consisting of amino acid numbers 2-69, 3-69, 5-69, 7-69 and 9-69 of SEQ ID NO: 2., which derivative has activity to enhance the efficacy of the vaccine.
9. The method of claim 1, wherein the one or more chemokine derivatives has one or more insertions or substitutions with one or more non-classical amino acids relative to a corresponding wildtype chemokine, which derivative has activity to enhance the efficacy of the vaccine.
10. The method of claim 1, including a chemokine derivative having one or more conservative substitutions in sequence relative a wildtype MDC, which derivative has activity to enhance the efficacy of the vaccine.
11. The method of claim 1, wherein the one or more chemokines include a human chemokine.



12. The method of claim 1, wherein the purified chemokine(s) or purified fragment(s) or derivative(s) thereof is/are administered concurrently with the purified antigen(s).
13. The method of claim 1 wherein the purified chemokine(s) or purified fragment(s) or derivative(s) thereof, are administered within a time period before or after administration of the purified antigen, which time period permits the purified MDC or purified fragment or derivative thereof MDC to enhance the efficacy of the vaccine.
14. The method of claim 1, wherein the antigen is an HIV antigen.
15. The method of claim 14, wherein the HIV antigen is HIV-associated gp120 protein.
16. The method of claim 1, wherein the subject is a human.
17. The method of claim 1, wherein the subject is infected or at risk of being infected with HIV virus.
18. The method of claim 1, wherein the vaccine elicits a humoral response against the antigen in the subject.
19. The method of claim 1, wherein the vaccine elicits a cell-mediated response against the antigen in the subject.
20. The method of claim 1, wherein the vaccine elicits both a humoral and a cell-mediated response against the antigen in the subject.
21. The method of claim 1, wherein the vaccine further comprises pharmaceutically acceptable excipient, auxiliary substance, adjuvant, wetting or emulsifying agent, or pH buffering agent.

22. A method to enhance the efficacy of a vaccine in a subject comprising administering to the subject a first amount of a first set of one or more purified nucleotide sequences encoding one or more antigens against which an immune response is desired in the subject and a second second set of one or more purified nucleic acids, each comprising a nucleotide sequence encoding one or more chemokines, or fragments or derivatives thereof, wherein the antigen(s) and the chemokine(s) are expressed in a coordinated manner upon introduction into a suitable cell, said first amount is immunogenic and said second amount is effective in enhancing the efficacy of the vaccine.
23. The method of claim 22, wherein the one or more chemokines are selected from a chemokine class selected from the group consisting of: CC, CXC, C-C and CX3C.
24. The method of claim 22, wherein the one or more chemokines are selected from the group consisting of: Macrophage-derived chemokine, Monocyte chemotactic protein 1, Monocyte chemotactic protein 2, Monocyte chemotactic protein 3, Monocyte chemotactic protein 4, activated macrophage specific chemokine 1, Macrophage inflammatory protein 1 alpha, Macrophage inflammatory protein 1 beta, Macrophage inflammatory protein 1 gamma, Macrophage inflammatory protein 1 delta, Macrophage inflammatory protein 2 alpha, Macrophage inflammatory protein 3 alpha, Macrophage inflammatory protein 3 beta, Regulated upon activation, normal T cell expressed and secreted (and its variants), I-309, EBI1-ligand chemokine, Pulmonary and activation regulated chemokine, Liver and activation-regulated chemokine, Thymus and activation regulated chemokine, Eotaxin (and variants), Human CC chemokine 1, Human CC chemokine 2, Human CC chemokine 3, IL-10-inducible chemokine, liver-expressed chemokine, 6Ckine, Exodus 1, Exodus 2, Exodus 3, thymus-expressed chemokine, Secondary Lymphoid tissue chemokine, Lymphocyte and Monocyte chemoattractant; Monotactin, Activation-induced, chemokine-related molecule, Myeloid progenitor inhibitory factor-1, Myeloid progenitor inhibitory factor-2, Stromal cell-derived factor 1 alpha, Stromal cell-derived factor 1 beta, B-cell-attracting chemokine

- 1, HuMIG, H174, Interferon-stimulated T-cell alpha chemoattractant, Interleukin-8, IP-10, platelet factor 4, growth-regulated gene-alpha, growth-regulated gene-beta, growth-regulated gene-gamma, Neutrophil-activating protein 2, ENA-78, granulocyte chemotactic protein 2, LYMPHOTACTIN, and Fractalkine/neurotactin.
25. The method of claim 22, wherein the one or more chemokines are selected from the group consisting of: MDC, SDF-1, BLC, and MCP-1.
26. The method of claim 22 wherein the fragment(s) or derivative(s) are truncation isoforms.
27. The method of claim 22, wherein the nucleotide sequence encoding one or more chemokines comprises the nucleotide sequence of SEQ ID NO:1.
28. The method of claim 22, wherein one or more of the chemokine derivative(s) have deletional, insertional or substitutional mutations and combination thereof, which derivative has activity to enhance the efficacy of the vaccine.
29. The method of claim 22, wherein the vaccine elicits a humoral response against the antigen in the subject.
30. The method of claim 22, wherein the vaccine elicits a cell-mediated response against the antigen in the subject.
31. The method of claim 22, wherein the vaccine elicits both a humoral and a cell-mediated response against the antigen in the subject.
32. The method of claim 22, wherein the vaccine further comprises pharmaceutically acceptable excipient, auxiliary substance, adjuvant, wetting or emulsifying agent, or pH buffering agent.
33. A composition comprising: an immunogenic amount of one or more purified antigens and an amount of one or more purified chemokines, or purified

fragments or derivatives thereof, effective to enhance the immune response to said antigen(s); and a pharmaceutically acceptable carrier.

34. The composition of claim 33, wherein the one or more chemokines are selected from the group consisting of: MDC, SDF-1, BLC, and MCP-1.
35. The composition of claim 33, wherein the one or more chemokines are selected from a chemokine class selected from the group consisting of: CC, CXC, C-C and CX3C.
36. The composition of claim 33, wherein the one or more chemokines are selected from the group consisting of: Macrophage-derived chemokine, Monocyte chemotactic protein 1, Monocyte chemotactic protein 2, Monocyte chemotactic protein 3, Monocyte chemotactic protein 4, activated macrophage specific chemokine 1, Macrophage inflammatory protein 1 alpha, Macrophage inflammatory protein 1 beta, Macrophage inflammatory protein 1 gamma, Macrophage inflammatory protein 1 delta, Macrophage inflammatory protein 2 alpha, Macrophage inflammatory protein 3 alpha, Macrophage inflammatory protein 3 beta, Regulated upon activation, normal T cell expressed and secreted (and its variants), I-309, EBI1-ligand chemokine, Pulmonary and activation regulated chemokine, Liver and activation-regulated chemokine, Thymus and activation regulated chemokine, Eotaxin (and variants), Human CC chemokine 1, Human CC chemokine 2, Human CC chemokine 3, IL-10-inducible chemokine, liver-expressed chemokine, 6Ckine, Exodus 1, Exodus 2, Exodus 3, thymus-expressed chemokine, Secondary Lymphoid tissue chemokine, Lymphocyte and Monocyte chemoattractant; Monotactin, Activation-induced, chemokine-related molecule, Myeloid progenitor inhibitory factor-1, Myeloid progenitor inhibitory factor-2, Stromal cell-derived factor 1 alpha, Stromal cell-derived factor 1 beta, B-cell-attracting chemokine 1, HuMIG, H174, Interferon-stimulated T-cell alpha chemoattractant, Interleukin-8, IP-10, platelet factor 4, growth-regulated gene-alpha, growth-regulated gene-beta, growth-regulated gene-gamma, Neutrophil-activating

protein 2, ENA-78, granulocyte chemotactic protein 2, LYMPHOTACTIN, and Fractalkine/neurotactin.

37. The composition of claim 33, wherein the fragment(s) or derivative(s) are truncation isoforms.
38. The composition of claim 33, wherein the one or more chemokine fragment includes an MDC fragment selected from the group consisting of amino acid numbers 2-69, 3-69, 5-69, 7-69 and 9-69 of SEQ ID NO: 2.
39. The composition of claim 33, wherein the one or more chemokine fragment includes an MDC fragment selected from the group consisting of amino acid numbers 2-69, 3-69, 5-69, 7-69 and 9-69 of SEQ ID NO: 2, which derivative has activity to enhance the efficacy of the vaccine.
40. The composition of claim 33, wherein the one or more chemokine derivatives has one or more insertions of or substitutions with one or more non-classical amino acids relative to a corresponding wildtype chemokine, which derivative has activity to enhance the efficacy of the vaccine.
41. The composition of claim 33, wherein the one or more chemokine derivatives has one or more conservative substitutions in sequence relative a corresponding wildtype chemokine, which derivative has activity to enhance the efficacy of the vaccine.
42. The composition of claim 33, wherein the chemokine is a human chemokine.
43. The composition of claim 33, wherein the antigen is an HIV antigen.
44. The composition of claim 43, wherein the antigen is HIV associated gp120 protein.
45. A composition comprising an amount of a first set of purified nucleic acids comprising one or more nucleotide sequences encoding one or more antigens



and a second set of purified nucleic acids comprising one or more nucleotide sequences encoding one or more chemokines, or fragments or derivatives thereof, wherein the antigen(s) and the chemokine(s), or fragment(s) or derivative(s) thereof, are expressed from said first set of nucleic acid(s) and second set of nucleic acid(s) in a coordinated manner such that upon introduction into a suitable cell, the amount of said first set of nucleic acid(s) is sufficient to express an immunogenic amount of the antigen and the amount of the said second set of nucleic acid(s) is effective in enhancing the efficacy of the vaccine; and a pharmaceutically acceptable carrier.

46. The composition of claim 45, wherein the chemokine is MDC and the nucleic acid encoding the MDC comprises the nucleotide sequence of SEQ ID NO: 1.
47. The composition of claim 45, wherein the chemokine derivative(s) have deletional, insertional or substitutional mutations and/or combinations thereof, and the derivative(s) have activity to enhance the efficacy of the vaccine.
48. The composition of claim 45, further comprising pharmaceutically acceptable excipient, auxiliary substance, adjuvant, wetting or emulsifying agent, or pH buffering agent.
49. A composition comprising a first set of purified nucleotide sequences encoding one or more antigens and a second set of purified nucleotide sequences encoding one or more chemokines, or fragments or derivatives thereof, wherein the antigen(s) and the chemokine(s) are expressed in a coordinated manner such that upon introduction into a suitable cell, the sets produce an amount of said antigen(s) that is immunogenic and an amount of chemokine(s), or fragment(s) or derivative(s) thereof, that is effective in enhancing the efficacy of the vaccine relative to a corresponding vaccine composition without such chemokine(s), fragment(s) or derivative(s) thereof.
50. The composition of claim 49, wherein the one or more chemokines are selected from the group consisting of: Macrophage-derived chemokine,

Monocyte chemotactic protein 1, Monocyte chemotactic protein 2, Monocyte chemotactic protein 3, Monocyte chemotactic protein 4, activated macrophage specific chemokine 1, Macrophage inflammatory protein 1 alpha, Macrophage inflammatory protein 1 beta, Macrophage inflammatory protein 1 gamma, Macrophage inflammatory protein 1 delta, Macrophage inflammatory protein 2 alpha, Macrophage inflammatory protein 3 alpha, Macrophage inflammatory protein 3 beta, Regulated upon activation, normal T cell expressed and secreted (and its variants), I-309, EBI1-ligand chemokine, Pulmonary and activation regulated chemokine, Liver and activation-regulated chemokine, Thymus and activation regulated chemokine, Eotaxin (and variants), Human CC chemokine 1, Human CC chemokine 2, Human CC chemokine 3, IL-10-inducible chemokine, liver-expressed chemokine, 6Ckine, Exodus 1, Exodus 2, Exodus 3, thymus-expressed chemokine, Secondary Lymphoid tissue chemokine, Lymphocyte and Monocyte chemoattractant; Monotactin, Activation-induced, chemokine-related molecule, Myeloid progenitor inhibitory factor-1, Myeloid progenitor inhibitory factor-2, Stromal cell-derived factor 1 alpha, Stromal cell-derived factor 1 beta, B-cell-attracting chemokine 1, HuMIG, H174, Interferon-stimulated T-cell alpha chemoattractant, Interleukin-8, IP-10, platelet factor 4, growth-regulated gene-alpha, growth-regulated gene-beta, growth-regulated gene-gamma, Neutrophil-activating protein 2, ENA-78, granulocyte chemotactic protein 2, LYMPHOTACTIN, and Fractalkine/neurotactin.

51. The method of claim 49, wherein the one or more chemokines are selected from a chemokine class selected from the group consisting of: CC, CXC, C-C and CX3C.
52. The method of claim 49, wherein the one or more chemokines are selected from the group consisting of: MDC, SDF-1, BLC, and MCP-1.
53. The composition of claim 49, wherein the fragment(s) or derivative(s) are truncation isoforms.

54. The composition of claim 49, wherein the nucleic acid is administered directly to the subject.
55. The composition of claim 49, wherein the nucleic acid is introduced into a suitable host cell and said suitable host cell is introduced into the subject.

1/6

GAGACATACA	GGACAGAGC	ATG	GCT	CGC	CTA	CAG	ACT	GCA	CTC	CTG	GTT	GTC	52			
Met Ala Arg Leu Gln Thr Ala Leu Leu Val Val																
-24 -20 -15																
CTC	GTC	CTC	CTT	GCT	GTG	GCG	CTT	CAA	GCA	ACT	GAG	GCA	GGC	CCC	TAC	100
Leu	Val	Leu	Leu	Ala	Val	Ala	Leu	Gln	Ala	Thr	Glu	Ala	Gly	Pro	Tyr	
-10 -5 1																
GGC	GCC	AAC	ATG	GAA	GAC	AGC	GTC	TGC	TGC	CGT	GAT	TAC	GTC	CGT	TAC	148
Gly	Ala	Asn	Met	Glu	Asp	Ser	Val	Cys	Cys	Arg	Asp	Tyr	Val	Arg	Tyr	
5 10 15																
CGT	CTG	CCC	CTG	CGC	GTG	GTG	AAA	CAC	TTC	TAC	TGG	ACC	TCA	GAC	TCC	196
Arg	Leu	Pro	Leu	Arg	Val	Val	Lys	His	Phe	Tyr	Trp	Thr	Ser	Asp	Ser	
20 25 30 35																
TGC	CCG	AGG	CCT	GGC	GTG	GTG	TTG	CTA	ACC	TTC	AGG	GAT	AAG	GAG	ATC	244
Cys	Pro	Arg	Pro	Gly	Val	Val	Leu	Leu	Thr	Phe	Arg	Asp	Lys	Glu	Ile	
40 45 50																
TGT	GCC	GAT	CCC	AGA	GTG	CCC	TGG	GTG	AAG	ATG	ATT	CTC	AAT	AAG	CTG	292
Cys	Ala	Asp	Pro	Arg	Val	Pro	Trp	Val	Lys	Met	Ile	Leu	Asn	Lys	Leu	
55 60 65																

FIG. 1A-1

348

AGC CAA TGAAGAGCCCT ACTCTGATGA CCGTGGCCCTT GGCTCCTCCA GGAAGGCTCA

Ser Gln

408

GGAGCCCTAC CTCCTGCCA TTATAGCTGC TCCCCGCCAG AAGCCTGTGC CAACTCTCTG

468

CATTCCCTGA TCTCCATCCC TGTGGCTGTC ACCCTTGGTC ACCTCCGTGC TGTCACTGCC

528

ATCTCCCCC TGACCCCTCT AACCCATCCT CTGCCCTCCCT CCTGCAGTC AGAGGGTCCT

588 2/6

GTTCCCATCA GCGATTCCCC TGCTTAAACC CTTCCATGAC TCCCCACTGC CCTAAGCTGA

648

GGTCAGTCTC CCAAGCCTGG CATGTGGCCC TCTGGATCTG GGTTCCATCT CTGTCTCCAG

708

CCTGCCCACT TCCCTTCATG AATGTTGGGT TCTAGCTCCC TGTTCTCCAA ACCCATACTA

768

CACATCCCAC TTCTGGGTCT TTGCCCTGGGA TGTGCTGAC ACTCAGAAAG TCCCACCACC

828

TGCACATGTG TAGCCCCACC AGCCCTCCAA GGCAATGCTC GCCAAGCAG CTGGTAATTC

888

CATTTCATGT ATTAGATGTC CCTGGCCCT CTGTCCCCCTC TTAATAACCC TAGTCACAGT

948

CTCCGCAGAT TCTTGGGATT TGGGGTTTT CTCCCCCACC TCTCCACTAG TTGGACCAAG

FIG. 1A-2



<u>GTTTCTAGCT</u>	<u>AAGTTACTCT</u>	<u>AGTCTCCAAG</u>	<u>CCTCTAGCAT</u>	<u>AGAGCACTGC</u>	<u>AGACAGGCC</u>	1008
TGGCTCAGAA	TCAGAGCCCA	GAAAGTGGCT	GCAGACAAA	TCAATAAAC	TAAATGTCCT	1068
CCCCTCTCCC	TGCCAAAAGG	CAGTTACATA	TCAATACAGA	GACTCAAGGT	CACTAGAAAT	1128
GGGCCAGCTG	GGTCAATGTG	AAGCCCCAAA	TTTGCCCAGA	TTCACCTTTC	TTCCCCCACT	1188
CCCTTTTTTT	TTTTTTTTTT	TTTGAGATGG	AGTTTCGCTC	TTGTCACCCA	CGCTGGAGTG	1248
CAATGGTGTG	GTCTTGGCTT	ATTGAAGCCT	CTGCCCTCCTG	GGTCAAGTG	ATTCTCTTGC	1308
CTCAGCCTCC	TGAGTAGCTG	GGATTACAGG	TTCCCTGCTAC	CACGCCCAGC	TAAATTTTGT	1368
ATTTTtagTA	GAGACGAGGC	ttcaccatGT	TGGCCAGGCT	GGTCTCGAAC	TCCTGTCCCTC	1428
AGGTAATCCG	CCCACCTCAG	CCTCCCCAAG	TGCTGGGATT	ACAGGCCGTGA	GCCACAGTGC	1488
CTGGCCTCTT	CCCTCTCCCC	ACTGCCCCCC	CCAACTTTTT	TTTTTTTTTT	ATGGCAGGGT	1548
CTCACTCTGT	CGCCCAGGCT	GGAGTGCAGT	GGCGTGATCT	CGGCTCACTA	CAACCTCGAC	1608
<u>CTCCTGGGTT</u>	<u>CAAGTGATTC</u>	<u>TCCCACCCCA</u>	<u>GCCTCCCAAG</u>	<u>TAGCTGGGAT</u>	<u>TACAGGTGTG</u>	1668

3/6

FIG. 1A-3

<u>TGCCACTACG</u>	<u>GCTGGCTAAT</u>	<u>TTTTGTATTT</u>	<u>TTAGTAGAGA</u>	<u>CAGTTTCAC</u>	<u>CATATTGGCC</u>	1728
AGGCTGGTCT	TGAACTCCTG	ACCTCAAGTG	ATCCACCTTC	CTTGCTCTCC	CAAAGTGCTG	1788
AGATTACAGG	CGTGAGCTAT	CACACCCAGC	CTCCCCCTTT	TTTTCCTAAT	AGGAGACTCC	1848
TGTACCTTTC	TTCGTTTTAC	CTATGTGTCG	TGCTGCTTA	CATTTCCTTC	TCCCCCTCAGG	1908
CTTTTTTTGG	GTGGTCCTCC	AACCTCCAAT	ACCCAGGCCT	GGCCTCTTCA	GAGTACCCCC	1968
CATTCCACTT	TCCCTGCCTC	CTTCCTTAAA	TAGCTGACAA	TCAAATTTCAT	GCTATGGTGT	2028
GAAAGACTAC	CTTTGACTTG	GTATTATAAG	CTGGAGTTAT	ATATGTATTT	GAAAACAGAG	2088
TAAATACTTA	AGAGGCCAAA	TAGATGAATG	GAAGAAATTT	AGGAACTGTG	AGAGGGGGAC	2148
AAGGTGAAGC	TTTCCTGGCC	CTGGGAGGAA	GCTGGCTGTG	GTAGCGTAGC	GCTCTCTCTC	2208
TCTGTCTGTG	GCAGGAGCCA	AAGAGTAGGG	TGTAATTGAG	TGAAGGAATC	CTGGGTAGAG	2268
ACCATTCCTCA	GGTGGTTGGG	CCAGGCTAAA	GACTGGGAGT	TGGGTCTATC	TATGCCCTTC	2328
<u>TGGCTGATTT</u>	<u>TTGTAGAGAC</u>	<u>GGGGTTTTC</u>	<u>CATGTTACCC</u>	<u>AGGCTGGTCT</u>	<u>CAAACCTCCTG</u>	2388

FIG. 1A-4

GGCTCAAGCG ATCCTCCTGG CTCAGCCTCC CAAAGTGCTG GGATTACAGG CGTGAATCAC 2448

TGCGCCTGGC TTCCCTCTCC TCTTGAGAAA TATTCCTTTC ATACAGCAAG TATGGACAG 2508

CAGTGTCCCA GGTAAGGAC ATAAATGTTA CAAGTGCTG GTCCTTCTG AGGAGGCTG 2568

GTGCCGCTCT GCAGGGTATT TGAACCTGTG GAATTGGAGG AGGCCATTTC ACTCCCTGAA 2628

CCCAGCCTGA CAAATCACAG TGAGAAATGTT CACCTTATAG GCTTGCTGTG GGGCTCAGGT 2688

TGAAAGTGTG GGGAGTGACA CTGCCTAGGC ATCCAGCTCA GTGTCAATCCA GGGCCTGTGT 2748<sup>5/6</sup>

CCCTCCCGAA CCCAGGGTCA ACCTGCCTGC CACAGGCACT AGAAGGACGA ATCTGCCTAC 2808

TGCCCATGAA CGGGGCCCTC AAGCGTCCTG GGATCTCCTT CTCCCTCCTG TCCTGTCCTT 2868

GCCCCTCAGG ACTGCTGGAA AATAAATCCT TTAAAAATAGT AAAAAAATAA 2923

FIG. 1A-5

FIG. 1A

FIG. 1A-1
FIG. 1A-2
FIG. 1A-3
FIG. 1A-4
FIG. 1A-5

6/6

Met	Ala	Arg	Leu	Gln	Thr	Ala	Leu	Leu	Val	Val	Leu	Val	Leu	Leu	Ala
-24				-20					-15				-10		
Val	Ala	Leu	Gln	Ala	Thr	Glu	Ala	Gly	Pro	Tyr	Gly	Ala	Asn	Met	Glu
			-5					1				5			
Asp	Ser	Val	Cys	Cys	Arg	Asp	Tyr	Val	Arg	Tyr	Arg	Leu	Pro	Leu	Arg
	10					15					20				
Val	Lys	His	Phe	Tyr	Tyr	Trp	Thr	Ser	Asp	Ser	Cys	Pro	Arg	Pro	Gly
25				30					35						40
Val	Val	Leu	Leu	Thr	Phe	Arg	Asp	Lys	Glu	Ile	Cys	Ala	Asp	Pro	Arg
				45					50					55	
Val	Pro	Trp	Val	Lys	Met	Ile	Leu	Asn	Lys	Leu	Ser	Gln			
								65							

**BIG**

## SEQUENCE LISTING

## (1) GENERAL INFORMATION

(i) APPLICANT: Gallo, Robert C.  
DeVico, Anthony L.  
Garzino, Alfredo

(ii) TITLE OF THE INVENTION: METHOD AND COMPOSITION TO ENHANCE  
THE EFFICACY OF A VACCINE USING MACROPHAGE DERIVED CHEMOKINE

(iii) NUMBER OF SEQUENCES: 2

(iv) CORRESPONDENCE ADDRESS:

(A) ADDRESSEE: Pennie & Edmonds LLP  
(B) STREET: 1155 Avenue of the Americas  
(C) CITY: New York  
(D) STATE: New York  
(E) COUNTRY: USA  
(F) ZIP: 10036/2711

(v) COMPUTER READABLE FORM:

(A) MEDIUM TYPE: Diskette  
(B) COMPUTER: IBM Compatible  
(C) OPERATING SYSTEM: DOS  
(D) SOFTWARE: FastSEQ Version 2.0

(vi) CURRENT APPLICATION DATA:

(A) APPLICATION NUMBER: To be assigned  
(B) FILING DATE: Herewith  
(C) CLASSIFICATION:

(viii) ATTORNEY/AGENT INFORMATION:

(A) NAME: Misrock, S. Leslie  
(B) REGISTRATION NUMBER: 18,872  
(C) REFERENCE/DOCKET NUMBER: 8769-029

(ix) TELECOMMUNICATION INFORMATION:

(A) TELEPHONE: 212-790-9090  
(B) TELEFAX: 212-869-8864  
(C) TELEX: 66141 PENNIE

## (2) INFORMATION FOR SEQ ID NO:1:

(i) SEQUENCE CHARACTERISTICS:

(A) LENGTH: 2923 base pairs  
(B) TYPE: nucleic acid  
(C) STRANDEDNESS: single  
(D) TOPOLOGY: linear

(ii) MOLECULE TYPE: DNA

(ix) FEATURE:

(A) NAME/KEY: mat\_peptide  
(B) LOCATION: 92..298

(xi) SEQUENCE DESCRIPTION: SEQ ID NO:1:

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		-24				-20							
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Leu	Val	Leu	Ala	Val	Ala	Leu	Gln	Ala	Thr	Glu	Ala	Gly	Pro
		-10				-5						1	100
GGC	GCC	AAC	ATG	GAA	GAC	AGC	GTC	TGC	CGT	GAT	TAC	GTC	CGT
Gly	Ala	Asn	Met	Glu	Asp	Ser	Val	Cys	Arg	Asp	Tyr	Val	Arg
	5				10				15				148
CGT	CTG	CCC	CTG	CGC	GTG	AAA	CAC	TTC	TAC	TGG	ACC	TCA	GAC
Arg	Leu	Pro	Leu	Arg	Val	Lys	His	Phe	Tyr	Trp	Thr	Ser	Asp
20				25				30					35
TGC	CCG	AGG	CCT	GGC	GTG	TTG	CTA	ACC	TTC	AGG	GAT	AAG	GAG
Cys	Pro	Arg	Pro	Gly	Val	Leu	Thr	Phe	Arg	Asp	Lys	Glu	Ile
			40					45				50	
TGT	GCC	GAT	CCC	AGA	GTG	CCC	TGG	GTG	AAG	ATG	ATT	CTC	AAT
Cys	Ala	Asp	Pro	Arg	Val	Pro	Trp	Val	Lys	Met	Ile	Leu	Asn
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Ser	Gln												348



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CCTGCCCCACT TCCCTTCATG AATGTTGGGT TCTAGCTCCC TGTTCCTCAA ACCCATACTA 708
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## (2) INFORMATION FOR SEQ ID NO:2:

## (i) SEQUENCE CHARACTERISTICS:

(A) LENGTH: 93 amino acids

(B) TYPE: amino acid

(D) TOPOLOGY: linear

## (ii) MOLECULE TYPE: protein

## (xi) SEQUENCE DESCRIPTION: SEQ ID NO:2:

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10 15 20
Val Lys His Phe Tyr Trp Thr Ser Asp Ser Cys Pro Arg Pro Gly
25 30 35 40
Val Leu Thr Phe Arg Asp Lys Glu Ile Cys Ala Asp Pro Arg
45 50 55
Val Pro Trp Val Lys Met Ile Leu Asn Lys Leu Ser Gln
60 65

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C-CHEMOKINES  
LYMPHOTACTIN

(SCM-1)

D63789 D63790

CX3C-chemokines  
Fractalkine/neurotactin

U91835 U84487

LOCUS HSU83171 2923 bp mRNA  
 DEFINITION Human macrophage-derived chemokine precursor (MDC) mRNA, complete  
 cds.  
 ACCESSION U83171  
 NID g1931580  
 KEYWORDS  
 SOURCE human.  
 ORGANISM Homo sapiens  
 Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata; Vertebrata; Mammalia; Eutheria; Primates; Catarrhini; Hominidae; Homo.  
 REFERENCE 1 (bases 1 to 2923)  
 AUTHORS Godiska, R., Chantry, D., Raport, C.J., Sozzani, S., Allavena, P., Leviten, D., Mantovani, A. and Gray, P.W.  
 TITLE Human macrophage-derived chemokine (MDC), a novel chemoattractant for monocytes, monocyte-derived dendritic cells, and natural killer cells  
 JOURNAL J. Exp. Med. 185 (9), 1595-1604 (1997)  
 MEDLINE 97296313  
 REFERENCE 2 (bases 1 to 2923)  
 AUTHORS Godiska, R. and Gray, P.W.  
 TITLE Direct Submission  
 JOURNAL Submitted (23-DEC-1996) ICOS Corporation, 22021 20th Avenue SE, Bothell, WA 98021, USA  
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 repeat\_region complement(2335..2443)  
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 61 ccttgctgtg gcgcttcaag caactgaggc aggccctac ggcgccaaca tggagacag  
 121 cgtctgtgct cgtgattacg tccgttaccg tctgcccctg cgcgtggtga aacacttcta  
 181 ctggacctca gactcctgcc cgaggcctgg cgtggtggtg ctaaccttca gggataagga  
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 421 tccatccctg tggctgtcac ccttggtcac ctccgtgctg tcaactgcat cccccctg  
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ACCESSION  U83239
NID        g2062424
KEYWORDS
SOURCE     human.
ORGANISM   Homo sapiens
            Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;
            Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.
REFERENCE  1 (bases 1 to 932)
AUTHORS    Chang,M.S., McNinch,J., Elias III,C., Manthey,C.L.,
            Grosshans,D., Meng,T., Boone,T. and Andrew,D.P.
TITLE      Molecular cloning and functional characterization of a novel CC
            chemokine STCP-1 which specifically acts on activated T
            lymphocytes
JOURNAL    Unpublished
REFERENCE  2 (bases 1 to 932)
AUTHORS    Chang,M.S., McNinch,J., Elias III,C., Manthey,C.L.,
            Grosshans,D., Meng,T., Boone,T. and Andrew,D.P.
TITLE      Direct Submission
JOURNAL    Submitted (26-DEC-1996) Research Computing, Amgen Institute,
            620 University Ave, Suite 706, Toronto, ON M5G 2C1, Canada
FEATURES   Location/Qualifiers
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DEFINITION H.sapiens mRNA for monocyte chemoattractant protein 1 (MCP-1).  
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NID g34513  
KEYWORDS monocyte chemoattractant protein 1.  
SOURCE human.  
ORGANISM Homo sapiens  
Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;  
Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.  
REFERENCE 1 (bases 1 to 725)  
AUTHORS Yoshimura,T., Yuhki,N., Moore,S.K., Appella,E., Lerman,M.I. and  
Leonard,E.J.  
TITLE Human monocyte chemoattractant protein-1 (MCP-1). Full-length  
cDNA

cloning, expression in mitogen-stimulated blood mononuclear  
leukocytes, and sequence similarity to mouse competence gene JE  
JOURNAL FEBS Lett. 244 (2), 487-493 (1989)  
MEDLINE 89153605  
COMMENT ZAPII.

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541 gatacagaga cttggggaaa ttgcttttcc tcttgaacca cagttctacc cctgggatgt
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ACCESSION  X99886
NID        gl905800
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SOURCE     human.
  ORGANISM Homo sapiens
            Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;
            Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.
REFERENCE  1 (bases 1 to 2991)
AUTHORS    Van Coillie,E., Fiten,P., Nomiyama,H., Sakaki,Y., Miura,R.,
            Yoshie,O., Van Damme,J. and Opdenakker,G.
TITLE      The human MCP-2 gene (SCYA8): cloning, sequence analysis,
tissue     expression, and assignment to the CC chemokine gene contig on
            chromosome 17q11.2
JOURNAL     Genomics 40 (2), 323-331 (1997)
MEDLINE     97237052
REFERENCE  2 (bases 1 to 2991)
AUTHORS     Opdenakker,G.M.M.
TITLE      Direct Submission
JOURNAL     Submitted (07-AUG-1996) G.M.M. Opdenakker, Rega Institute for
            Medical Research, Minderbroedersstraat 10, B 3000 Leuven,
            BELGIUM
FEATURES   Location/Qualifiers
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                        /db_xref="taxon:9606"
                        /chromosome="17"
                        /map="q11.2"
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DEFINITION   Homo sapiens mRNA for monocyte chemotactic protein-2.
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NID          g2916795
KEYWORDS     MCP-2 gene; monocyte chemotactic protein 2.
SOURCE       human.
ORGANISM     Homo sapiens
              Eukaryota; Metazoa; Chordata; Vertebrata; Mammalia; Eutheria;
              Primates; Catarrhini; Hominidae; Homo.
REFERENCE    1 (bases 1 to 1368)
AUTHORS      Van Coillie, E.
TITLE        Functional comparison of two human monocyte chemotactic
              protein-2
              isoforms, role of the amino-terminal pyroglutamic acid and
              processing by CD26/dipeptidyl peptidase IV
JOURNAL      Biochemistry 37, 12672-12680 (1998)
REFERENCE    2 (bases 1 to 1368)
AUTHORS      Van Coillie, E.
TITLE        Direct Submission
JOURNAL      Submitted (23-FEB-1998) E. Van Coillie, Rega Institute for
              Medical
              Research, Minderbroedersstraat 10, 3000 Leuven, BELGIUM
COMMENT      Related sequences: X99886, Y10802.
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BASE COUNT 457 a 292 c 243 g 376 t

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301 gcttactcag catattcaag gaaggcttta cttcattctt ccttgattgt gaccatgccc
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DEFINITION   H.sapiens MCP-3 mRNA for monocyte chemotactic protein-3.
ACCESSION    X72308 S57464
NID          g313707
KEYWORDS     monocyte chemotactic protein 3.
SOURCE       human.
ORGANISM     Homo sapiens
              Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;
              Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.
REFERENCE    1 (bases 1 to 1085)
AUTHORS      Opdenakker,G., Froyen,G., Fiten,P., Proost,P. and Van Damme,J.
TITLE        Human monocyte chemotactic protein-3 (MCP-3): molecular cloning
of           the cDNA and comparison with other chemokines
              JOURNAL      Biochem. Biophys. Res. Commun. 191 (2), 535-542 (1993)
              MEDLINE      93213290
REFERENCE    2 (bases 1 to 1085)
AUTHORS      Opdenakker,G.M.
TITLE        Direct Submission
JOURNAL      Submitted (27-MAY-1993) G.M. Opdenakker, Rega Institute,
University   of Leuven, Minderbroedersstraat 10, B-3000 Leuven, BELGIUM
REFERENCE    3 (bases 1 to 1085)
AUTHORS      Opdenakker,G., Fiten,P., Nys,G., Froyen,G., Van Roy,N.,
              Speleman,F., Laureys,G. and Van Damme,J.
TITLE        The human MCP-3 gene (SCYA7): cloning, sequence analysis, and
              assignment to the C-C chemokine gene cluster on chromosome
              17q11.2-q12
JOURNAL      Genomics 21 (2), 403-408 (1994)
MEDLINE      94375065
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LOCUS      HSMCP3A      1085 bp      DNA      PRI      25-JUL-1994
DEFINITION H.sapiens MCP-3 mRNA for monocyte chemotactic protein-3.
ACCESSION  X72308 S57464
NID        g313707
KEYWORDS   monocyte chemotactic protein 3.
SOURCE     human.
ORGANISM   Homo sapiens
            Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;
            Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.
REFERENCE  1 (bases 1 to 1085)
AUTHORS    Opdenakker,G., Froyen,G., Fiten,P., Proost,P. and Van Damme,J.
TITLE      Human monocyte chemotactic protein-3 (MCP-3): molecular cloning
of         the cDNA and comparison with other chemokines
            JOURNAL      Biochem. Biophys. Res. Commun. 191 (2), 535-542 (1993)
            MEDLINE      93213290
REFERENCE  2 (bases 1 to 1085)
AUTHORS    Opdenakker,G.M.
TITLE      Direct Submission
JOURNAL    Submitted (27-MAY-1993) G.M. Opdenakker, Rega Institute,
University of Leuven, Minderbroedersstraat 10, B-3000 Leuven, BELGIUM
REFERENCE  3 (bases 1 to 1085)
AUTHORS    Opdenakker,G., Fiten,P., Nys,G., Froyen,G., Van Roy,N.,
            Speleman,F., Laureys,G. and Van Damme,J.
TITLE      The human MCP-3 gene (SCYA7): cloning, sequence analysis, and
            assignment to the C-C chemokine gene cluster on chromosome
            17q11.2-q12
            JOURNAL      Genomics 21 (2), 403-408 (1994)
            MEDLINE      94375065
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1081 aaaaa

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DEFINITION Human monocyte chemoattractant protein-4 precursor (MCP-4)
mRNA,
complete cds.
ACCESSION U46767
NID gl732122
KEYWORDS
SOURCE human.
ORGANISM Homo sapiens
Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;
Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.
REFERENCE 1 (bases 1 to 825)
AUTHORS Garcia-Zepeda, E.A., Combadiere, C.C., Rothenberg, M.E.,
Sarafi, M.N.,
Lavigne, F., Hamid, Q., Murphy, P. and Luster, A.D.
TITLE Human monocyte chemoattractant Protein (MCP)-4: A novel CC
chemokine with activities on monocytes, eosinophils, and
basophils
induced in allergic and non-allergic inflammation that signals
through the CC chemokine receptors CCR-2 and 3
JOURNAL J. Immunol. 158 (1996) In press
REFERENCE 2 (bases 1 to 825)
AUTHORS Garcia-Zepeda, E.A. and Luster, A.D.
TITLE Direct Submission
JOURNAL Submitted (22-JAN-1996) Eduardo A. Garcia-Zepeda, Infectious
Disease Unit, Massachusetts General Hospital, 149 13th St.,
Charlestown, MA 02129, USA
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CDS 34..330
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signature; chemoattractant for monocytes, eosinophils"
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BASE COUNT 221 a 175 c 185 g 244 t

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661 agtcatggac atgaagggat gctgcaatgt aggaaggaga gctctttgtg aatgtgaggt
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//LOCUS HSAMAC1 803 bp RNA PRI 10-AUG-1997  
 DEFINITION Homo sapiens mRNA for alternative activated macrophage specific  
 CC

chemokine 1.

ACCESSION Y13710

NID g2326515

KEYWORDS AMAC-1 gene; CC-chemokine 1.

SOURCE human. ORGANISM Homo sapiens

Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;  
 Vertebrata; Mammalia; Eutheria; Primates; Catarrhini;

Hominidae;

Homo.

REFERENCE 1 (bases 1 to 803)

AUTHORS Politz,O.

TITLE Direct Submission

JOURNAL Submitted (10-JUN-1997) Politz O., Dermatology, Free University  
 Benjamin Franklin Medical Center, Hindenburgdamm 30; 12200

Berlin

GERMANY

REFERENCE 2 (bases 1 to 803)

AUTHORS Kodelja,V., Mueller,C., Politz,O., Hakiy,N., Orfanos,C.E. and  
 Goerdts,S.

TITLE Cloning of alternative activated macrophage associated CC  
 chemokine

1 (AMAC-1)

JOURNAL Unpublished

FEATURES Location/Qualifiers

source

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/organism="Homo sapiens"

/db\_xref="taxon:9606"

/cell\_type="macrophage"

sig\_peptide

71..133

/gene="amac-1"

CDS

71..340

/gene="amac-1"

/note="macrophage specific"

/codon\_start=1

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/db\_xref="PID:e321838"

/db\_xref="PID:g2326516"

/translation="MKGLAAALLVLVCTMALCSAQVGTNKLCCLVYTSWQIPQKFI  
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gene

71..340

/gene="amac-1"

mat\_peptide

134..337

/gene="amac-1"

BASE COUNT 214 a 213 c 160 g 216 t

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121 ctgctcctgt gcacaagttg gtaccaacaa agagctctgc tgcctcgtct atacctcctg
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661 cagacattgt gccatatgta tcaaatgaca aatcttttatt gaatggtttt gctcagcacc
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781 aaaaaaaaaa aaaaaaaaaa aaa

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LOCUS      HUMLD78A      3176 bp      DNA                      PRI      17-JAN-1992
DEFINITION Human LD78 alpha gene.
ACCESSION  D90144
NID        g219905
KEYWORDS   LD78; LD78 alpha; cytokine; inducible gene family; secreted
           peptide.
SOURCE     Human blood lymphocyte DNA, clone Lm LD-3.
ORGANISM   Homo sapiens
           Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;
           Vertebrata; Mammalia; Eutheria; Primates; Catarrhini;
Hominidae; Homo.
REFERENCE  1 (bases 1 to 3176)
AUTHORS    Nakao,M., Nomiyama,H. and Shimada,K.
TITLE      Structures of human genes coding for cytokine LD78 and their
           expression
JOURNAL    Mol. Cell. Biol. 10 (7), 3646-3658 (1990)
MEDLINE    90287155
COMMENT    These data kindly submitted in computer readable form by:
Hisayuki

```

```

           Nomiyama
           Department of Biochemistry
           Kumamoto University Medical School
           2-2-1 Honjo, Kumamoto 860
           Japan
           Phone: 096-344-2111
           Fax: 096-372-6140.
FEATURES   Location/Qualifiers
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                           /number=1
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                           /note="LD78 alpha mRNA and introns"
           sig_peptide     1155..1220
                           /note="LD78 alpha signal peptide"
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           intron          1228..1915
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BASE COUNT      833 a      741 c      752 g      850 t
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121 atatatgtgt atatgtacaa atacatgtat atatagtaca aatatatata tatatttgta
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241 tgttataagc atatttatgc cacttcattc attttagaga ctttaataata aatgatctag
301 tggataattt atcattccct gatggagaaa aatttagctt tgtttatttt agagttataa
361 acgatgctgg gtcaggtatc tttatgtttg aagatggctc catatttggg ttgtttccac
421 agaactcttt cctagaaatg ctttttctag gttaatggct acagatattt ctaggcacct
481 gacatattga caccacctc taaagtattt ttatgatcca caactagcgt ttaacacagc
541 gccctagtca ctacatgact aataaataga caaatgactg aaacatgacc tcatgctttc
601 tattcctcca gctttcattc agttctttgc ctctgggagg aggaagggtt gtgcagccct
661 ccacagcatc agcccatcaa ccctatccct gtggttatag cagctgagga agcagaattg
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841 catttcccta tgaaactata acaagtcatt agttgagagc tgagagttag agaatagctc
901 aaagatgcta ttcttgata tcttgagccc ctgtggtcac cagggacctt gagttgtgca
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1261 ctctggccat ggtagacca catcaatctt ttcttggtgc ctaaaagccc ccaagagaaa
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1561 taggtctccc aggagctctg tcccttggat gtcttatgag agatgtccaa ggcttctctt
1621 gggttggggg atgacttctt gaaccagaca aaattccctg aagagaactg agataagaga
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2821 aaccgagtgg ctgtcatcag cctgtgtagg cagtcatggc accaaagcca ccagactgac
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3061 agatggggag ggctaccaca gagttatcca ctttacaacg gagacacagt tctggaacat
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LOCUS      AF043339      225 bp      mRNA      PRI      23-FEB-1998
DEFINITION Homo sapiens macrophage inflammatory protein 1 alpha (MIP1a)
mRNA,
partial cds.
ACCESSION  AF043339
NID        g2905627
KEYWORDS
SOURCE     human.
ORGANISM   Homo sapiens
            Eukaryotae; Metazoa; Chordata; Vertebrata; Mammalia; Eutheria;
            Primates; Catarrhini; Hominidae; Homo.
REFERENCE  1 (bases 1 to 225)
AUTHORS    Jang, J.S. and Kim, B.E.
TITLE      Direct Submission
JOURNAL     Submitted (15-JAN-1998) Protein Engineering, General Institute

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of  
 Technology, Hyundai Pharm. Ind. Co., Ltd., 213 Sosa Bon 1-dong,  
 Sosa-gu, Bucheon 422-231, Korea  
 COMMENT forward primer (5'-tgcgcatcacttgctgctgaca-3')  
 reverse primer (5'-cttctggacccctcaggcact-3').  
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             /cell\_type="PHA-treated peripheral blood leukocyte"  
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             /PCR\_conditions="94C-1min, 50C-1min, 72C-3min, 30  
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 BASE COUNT 50 a 68 c 62 g 45 t  
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     121 atcttcctaa ccaagcgaag ccggcaggtc tgtgctgacc ccagtggagga gtgggtccag  
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 LOCUS HUMLD78B 3112 bp DNA PRI 17-JAN-1992  
 DEFINITION Human LD78 beta gene.  
 ACCESSION D90145  
 NID g219907  
 KEYWORDS LD78; LD78 beta; cytokine; inducible gene family; secreted  
 peptide.  
 SOURCE Human placenta DNA, clone Lm LD-1.  
     ORGANISM Homo sapiens  
             Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;  
             Vertebrata; Mammalia; Eutheria; Primates; Catarrhini;  
     Hominidae;  
     Homo.  
 REFERENCE 1 (bases 1 to 3112)  
     AUTHORS Nakao,M., Nomiya,H. and Shimada,K.  
     TITLE Structures of human genes coding for cytokine LD78 and their  
     expression  
     JOURNAL Mol. Cell. Biol. 10 (7), 3646-3658 (1990)  
     MEDLINE 90287155  
 COMMENT These data kindly submitted in computer readable form by:  
 Hisayuki  
     Nomiya  
     Department of Biochemistry  
     Kumamoto University Medical School  
     2-2-1 Honjo, Kumamoto 860  
     Japan  
     Phone: 096-344-2111  
     Fax: 096-372-6140.  
 FEATURES Location/Qualifiers  
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prim_transcript  1106..2995
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mat_peptide      join(1258..1267,1953..2067,2488..2575)
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exon             2488..2955
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2701 aaacagccac actgtgggac tcttcttaac ttaaatttta atttatttat actatttagt
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LOCUS      HUMACT2A      696 bp      mRNA      PRI      30-OCT-1994
DEFINITION Human activation (Act-2) mRNA, complete cds.
ACCESSION  J04130
NID        g178017
KEYWORDS   act2 gene; immune activation gene.
SOURCE     Human (Hut-102B2 library) activated T cells, cDNA to mRNA.
ORGANISM   Homo sapiens
            Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;
            Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.
REFERENCE  1 (bases 1 to 696)
AUTHORS    Lipes,M.A., Napolitano,M., Jeang,K.T., Chang,N.T. and
Leonard,W.J.
TITLE      Identification, cloning, and characterization of an immune
            activation gene
JOURNAL    Proc. Natl. Acad. Sci. U.S.A. 85 (24), 9704-9708 (1988)
MEDLINE    89071764
COMMENT    Draft entry and computer-readable sequence [1] kindly submitted
            by
            W.Leonard, 09-JAN-1989.

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BASE COUNT      157 a      203 c      139 g      197 t
ORIGIN           Unreported.

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61  tgagttctgc agcctcacct ctgagaaaac ctcttttcca ccaataccat gaagctctgc
121  gtgactgtcc tgtctctcct catgctagta gctgccttct gctctccagc gctctcagca
181  ccaatgggct cagaccctcc caccgcctgc tgcttttctt acaccgcgag gaagcttcct
241  cgcaactttg tggtagatta ctatgagacc agcagcctct gctcccagcc agctgtggta
301  ttccaaacca aaagaagcaa gcaagtctgt gctgatccca gtgaatcctg ggtccaggag
361  tacgtgtatg acctggaact gaactgagct gctcagagac aggaagtctt cagggaaggt
421  cacctgagcc cggatgcttc tccatgagac acatctcctc catactcagg actcctctcc
481  gcagttcctg tcccttctct taatttaate ttttttatgt gccgtgttat tgtattaggt
541  gtcatttcca ttatttatat tagtttagcc aaaggataag tgcctatgg ggatgggtcca
601  ctgtcactgt ttctctgctg ttgcaaatac atggataaca catttgattc tgtgtgtttt
661  ccataataaa actttaaaat aaaatgcaga cagtta

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LOCUS      AF031587      481 bp      mRNA      PRI      02-JAN-1998
DEFINITION Homo sapiens MIP-1 delta mRNA, complete cds.

```

ACCESSION AF031587  
 NID g2739163  
 KEYWORDS .  
 SOURCE human.  
 ORGANISM Homo sapiens  
 Eukaryotae; Metazoa; Chordata; Vertebrata; Mammalia; Eutheria;  
 Primates; Catarrhini; Hominidae; Homo.  
 REFERENCE 1 (bases 1 to 481)  
 AUTHORS Wang, W.  
 TITLE Molecular cloning and characterization of a new CC chemokine  
 MIP-1

delta  
 JOURNAL Unpublished  
 REFERENCE 2 (bases 1 to 481)  
 AUTHORS Wang, W.  
 TITLE Direct Submission  
 JOURNAL Submitted (27-OCT-1997) Immunobiology, DNAX Research Institute,  
 901

California Ave, Palo Alto, CA 94304, USA

FEATURES Location/Qualifiers  
 source 1..481  
 /organism="Homo sapiens"  
 /db\_xref="taxon:9606"  
 /chromosome="17"  
 CDS 1..342  
 /note="CC or beta chemokine"  
 /codon\_start=1  
 /product="MIP-1 delta"  
 /db\_xref="PID:g2739164"

/translation="MKVSVAALSCLMLVAVLGSQAQFINDAETELMMSKLPLENPVVL

NSFHFAADCCTSYISQSI PCSLMKSYFETSSECSKPGVIFLTKKGRQVCAKPSGPGVQ  
 DCMKKLKPYSI"

BASE COUNT 140 a 112 c 100 g 129 t  
 ORIGIN

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1 atgaaggtct cctgtggctgc cctctcctgc ctcattgctt ttgctgtcct tggatcccag
61 gccagttca taaatgatgc agagacagag ttaatgatgt caaagcttcc actggaaaat
121 ccagtagttc tgaacagctt tcacttttgc gctgactgct gcacctccta catctcacia
181 agcatcccggtttcactcat gaaaagttat ttgaaacga gcagcgagtgc ctccaagcca
241 ggtgtcatat tcctcaccaa gaaggggagg caagtctgtg ccaaaccagc tgggtccggga
301 gttcaggatt gcatgaaaaa gctgaagccc tactcaatat aataataaag agacaaaaga
361 gggcagccac ccacctcaa cacctcctgt gagtttcttg gtctgaaata cttaaaaaat
421 atatatttg ttgtgtctgg taatgaaagt aatgcatcta ataaagagta ttcaattttt
481 t

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//  
 LOCUS AF043340 234 bp mRNA PRI 23-FEB-1998  
 DEFINITION Homo sapiens macrophage inflammatory protein 2 alpha (MIP2a)  
 mRNA,

partial cds.

ACCESSION AF043340  
 NID g2905629

KEYWORDS .

SOURCE human.

ORGANISM Homo sapiens  
 Eukaryotae; Metazoa; Chordata; Vertebrata; Mammalia; Eutheria;  
 Primates; Catarrhini; Hominidae; Homo.

REFERENCE 1 (bases 1 to 234)

AUTHORS Jang, J.S. and Kim, B.E.

TITLE Direct Submission

JOURNAL Submitted (15-JAN-1998) Protein Engineering, General Institute  
 of

Technology, Hyundai Pharm. Ind. Co., Ltd., 213 Sosa Bon 1-dong,  
 Sosa-gu, Bucheon 422-231, Korea

COMMENT forward primer (5'-tgcgacccctggccactgaactg-3')  
 reverse primer (5'-ccttccttctggtcagttgga-3').

FEATURES Location/Qualifiers

source 1..234  
 /organism="Homo sapiens"  
 /db\_xref="taxon:9606"  
 /cell\_type="PHA-treated peripheral blood leukocyte"

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gene          <1..234
               /gene="MIP2a"
primer_bind   <1..21
               /gene="MIP2a"
               /PCR_conditions="94C-1min, 50C-1min, 72C-3min, 30
cycles;
               DeltaCycler II from Ericomp"
CDS           <1..222
               /gene="MIP2a"
               /function="CXC chemokine"
               /function="proinflammatory cytokine involved in
inflammation"
               /note="8-10 kDa"
               /codon_start=1
               /product="macrophage inflammatory protein 2 alpha"
               /db_xref="PID:g2905630"

/translation="APLATELRCQCLQTLQGIHLKNIQSVKVKSPGPHCAQTEVIATL
               KNGQKACLNPA SPMVKKIIEKMLKNGKSN"
primer_bind   complement(214..234)
               /gene="MIP2a"
BASE COUNT    74 a      70 c      54 g      36 t
ORIGIN
    1 gcacccctgg ccactgaact gcgctgccag tgcttgccaga ccctgcaggg aattcacctc
   61 aagaacatcc aaagtgtgaa ggtgaagtcc cccggacccc actgcgccc aaccgaagtc
  121 atagccacac tcaagaatgg gcagaaagct tgtctcaacc ccgcatcgcc catggttaag
  181 aaaatcatcg aaaagatgct gaaaaatggc aaatccaact gaccagaagg aagg
//
LOCUS          HSU77035      764 bp      mRNA          PRI          23-JAN-1997
DEFINITION     Human macrophage inflammatory protein 3 alpha (MIP-3a) mRNA,
               complete cds.
ACCESSION      U77035
NID            g1790924
KEYWORDS       .
SOURCE         human.
ORGANISM       Homo sapiens
               Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;
               Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.
REFERENCE      1 (bases 1 to 764)
AUTHORS        Rossi,D.L., Vicari,A.P., Franz-Bacon,K., McClanahan,T.K. and
               Zlotnik,A.
TITLE          Identification through bioinformatics of two new macrophage
               proinflammatory human chemokines: MIP-3alpha and MIP-3beta
JOURNAL        J. Immunol. 158 (3), 1033-1036 (1997)
MEDLINE        97166046
REFERENCE      2 (bases 1 to 764)
AUTHORS        Rossi,D.L. and Zlotnik,A.
TITLE          Direct Submission
JOURNAL        Submitted (31-OCT-1996) Immunology, DNAX Research Institute,
901            California Ave., Palo Alto, CA 94304, USA
FEATURES       Location/Qualifiers
               source          1..764
                           /organism="Homo sapiens"
                           /db_xref="taxon:9606"
                           /cell_type="elutriated monocytes activated with
                           LPS/IFN-GAMMA"
               gene           1..291
                           /gene="MIP-3a"
               CDS            1..291
                           /gene="MIP-3a"
                           /note="chemokine"
                           /codon_start=1
                           /product="macrophage inflammatory protein 3 alpha"
                           /db_xref="PID:g1790925"

/translation="MCCTKSLLLAALMSVLLHLGGESEAASNFDCCLGYTDRILHPK
               FIVGFTRQLANEGCDINAIIFHTKKKLSVCANPKQTWVKYIVRLLSKKVKNM"
BASE COUNT    235 a      121 c      146 g      260 t      2 others
ORIGIN
    1 atgtgctgta ccaagagttt gctcctggct gctttgatgt cagtgctgct actccacctc

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```

61 tgcggcgaat cagaagcagc aagcaacttt gactgctgtc ttggatacac agaccgtatt
121 cttcacccta aattttattgt gggcttcaca cggcagctgg ccaatgaagg ctgtgacatc
181 aatgctatca tctttcacac aaagaaaaag ttgtctgtgt gcgcaaatcc aaaacagact
241 tgggtgaaat atattgtgcg tctcctcagt aaaaaagtca agaacatgta aaaactgtgg
301 cttttctgga atggaattgg acatagccca agaacagaaa gaaccttgct ggggttgagg
361 gtttcacttg cacatcatgg agggtttagt gcttatctaa tttgtgcctc actggacttg
421 tccaattaat gaagttgatt catattgcat catagtttgc tttgtttaag catcacatta
481 aagttaaact gtattttatg ttatttatag ctgtagggtt tctgtgttta gctatttaat
541 actaattttc cataagctat tttggtttag tgcaaagtat aaaattatat ttggggggga
601 ataagattat atggactttt ttgcaagcaa caagctattt tttaaaamma actatttaac
661 attcttttgt ttatattgtt ttgtctccta aattgttgta attgcattat aaaataagaa
721 aaatattaat aagacaaata ttgaaaataa agaaacaaaa agtt

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//
LOCUS      HSU77180      545 bp      mRNA      PRI      23-JAN-1997
DEFINITION Human macrophage inflammatory protein 3 beta (MIP-3beta) mRNA,
complete cds.
ACCESSION  U77180
NID        gl791002
KEYWORDS
SOURCE     human.
ORGANISM   Homo sapiens
            Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;
            Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.
REFERENCE  1 (bases 1 to 545)
AUTHORS    Rossi,D.L., Vicari,A.P., Franz-Bacon,K., McClanahan,T.K. and
            Zlotnik,A.
TITLE      Identification through bioinformatics of two new macrophage
            proinflammatory human chemokines: MIP-3alpha and MIP-3beta
JOURNAL    J. Immunol. 158 (3), 1033-1036 (1997)
MEDLINE    97166046
REFERENCE  2 (bases 1 to 545)
AUTHORS    Vicari,A. and Zlotnik,A.
TITLE      Direct Submission
JOURNAL    Submitted (01-NOV-1996) Immunology, DNAX Research Institute,
901        California Ave, Palo Alto, CA 94304, USA
FEATURES   Location/Qualifiers
            source      1..545
                        /organism="Homo sapiens"
                        /db_xref="taxon:9606"
                        /cell_type="macrophages activated with LPS or IFNg"
                        /chromosome="9"
            gene        1..297
                        /gene="MIP-3beta"
            CDS          1..297
                        /gene="MIP-3beta"
                        /function="chemokine"
                        /codon_start=1
                        /product="macrophage inflammatory protein 3 beta"
                        /db_xref="PID:gl791003"

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/translation="MALLLALSLLVLWTSPAPTLSGTNDACCLSVTQKPIPGYIVR

NFHYLLIKDGCVRPAVVFTTLRGRQLCAPPDQPWVERIIQRLQRTSAKMKRRSS"

BASE COUNT 125 a 160 c 153 g 107 t

ORIGIN

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1 atggccctgc tactggccct cagcctgctg gttctctgga cttccccagc cccaactctg
61 agtggcacca atgatgctga agactgctgc ctgtctgtga cccagaaacc catccctggg
121 tacatcgtga ggaacttcca ctaccttctc atcaaggatg gctgcagggt gcctgctgta
181 gtgttcacca cactgagggg cgcagagctc tgtgcacccc cagaccagcc ctgggtagaa
241 cgcacatccc agagactgca gaggacctca gccaaagatga agcgccgcag cagttaacct
301 atgaccgtgc agaggagacc cggagtccga gtcaagcatt gtgaattatt acctaacctg
361 gggaaccgag gaccagaagg aaggaccagg cttccagctc ctctgcacca gacctgacca
421 gccaggacag ggcctggggg gtgtgtgagt gtgagtgtga gcgagagggt gagtgtggtc
481 tagagtaaag ctgctccacc cccagattgc aatgctacca ataaagccgc ctggtgttta
541 caact

```

```

//
LOCUS      HUMTCSM      1160 bp      mRNA      PRI      15-JUN-1989
DEFINITION Human T cell-specific protein (RANTES) mRNA, complete cds.
ACCESSION  M21121
NID        g339420

```



KEYWORDS Alu repeat; T-cell-specific protein.  
 SOURCE Human peripheral blood (T lymphocyte) cell line AH2, cDNA to mRNA,  
 ORGANISM clone 228.  
 Homo sapiens  
 Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;  
 Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.  
 REFERENCE 1 (bases 1 to 1160)  
 AUTHORS Schall, T.J., Jongstra, J., Dyer, B.J., Jorgensen, J., Clayberger, C., Davis, M.M. and Krensky, A.M.  
 TITLE A human T cell-specific molecule is a member of a new gene family  
 JOURNAL J. Immunol. 141, 1018-1025 (1988)  
 MEDLINE 88285659  
 COMMENT Draft entry and computer-readable sequence for [1] kindly provided by A.M.Krensky, 24-OCT-1988.  
 FEATURES  
 source Location/Qualifiers  
 1..1160  
 /organism="Homo sapiens"  
 /db\_xref="taxon:9606"  
 CDS  
 27..302  
 /note="T cell-specific protein precursor"  
 /codon\_start=1  
 /db\_xref="PID:g339421"  
 /translation="MKVSAARLAVILIATLALCAPASAPYSSDTPCCFAYIARPLPR  
 AHIKEYFYTSGKCSNPAVVFVTRKNRQVCANPEKKWVREYINSLEMS"  
 sig\_peptide 27..95  
 /note="T cell-specific protein signal peptide"  
 mat\_peptide 96..299  
 /note="T cell-specific protein"  
 repeat\_region 450..950  
 /note="Alu-related repeats"  
 BASE COUNT 298 a 332 c 295 g 235 t  
 ORIGIN 276 bp upstream of RsaI site.  
 1 cctccgacag cctctccaca ggtaccatga aggtctccgc ggcacgcctc gctgtcatcc  
 61 tcattgctac tgccctctgc gtccttgcac ctgcctcccc atattcctcg gacaccacac  
 121 cctgctgctt tgccctacatt gcccgccac tgcccgctgc ccacatcaag gagtatttct  
 181 acaccagtgg caagtgtctc aaccagcag tcgtctttgt caccgaaag aaccgccaag  
 241 tgtgtgcca cccagagaag aaatgggttc gggagtacat caactctttg gagatgagct  
 301 aggatggaga gtccttgaac ctgaacttac acaaatttgc ctgtttctgc ttgctcttgc  
 361 cctagcttgg gaggttccc ctactatcc taccacccc gtccttgaa gggcccagat  
 421 tctgaccacg acgagcagca gttacaaaaa ccttccccag gctggacgtg gtggctcagc  
 481 cttgtaatcc cagcactttg ggaggccaag gtgggtggat cacttgaggt caggagttcg  
 541 agacagcctg gccaacatga tgaaaccca tgtgtactaa aaatacaaaa aattagccgg  
 601 gcgtggtagc gggcgctgt agtcccagct actcgggagg ctgaggcagg agaatggcgt  
 661 gaaccggga gggagcttg cagtggccg agatcgccc actgcactcc agcctgggag  
 721 acagagcgag actccgtctc aaaaaaaaaa aaaaaaaaaa aaaaaataca aaaattagcc  
 781 gcgtggtagc ccacgcctgt aatcccagct actcgggagg ctaaggcagg aaaattgttt  
 841 gaaccagga ggtggaggct gcagtggct gagattgtgc cacttcactc cagcctgggt  
 901 gacaaagtga gactccgtca caacaacaac aacaaaaagc ttccccaact aaagcctaga  
 961 agagcttctg aggcgtgct ttgtcaaaag gaagtctcta ggttctgagc tctggcttgc  
 1021 ccttggcttt gcaagggtc tgtgacaagg aaggagtc gcatgcctct agaggcaagg  
 1081 aaggaggaa cactgcactc ttaagcttcc gccgtctcaa cccctcacag gagcttactg  
 1141 gcaaacatga aaaatcgggg  
 //  
 LOCUS HUMTLI309 520 bp mRNA PRI 14-JAN-1995  
 DEFINITION Human secreted protein (I-309) mRNA, complete cds.  
 ACCESSION M57502  
 NID g339728  
 KEYWORDS secreted protein.  
 SOURCE Human T-cell, cDNA to mRNA.  
 ORGANISM Homo sapiens  
 Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;  
 Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.  
 REFERENCE 1 (bases 1 to 520)  
 AUTHORS Miller, M.D., Hata, S., De Waal Malefyt, R. and Krangel, M.S.  
 TITLE A novel polypeptide secreted by activated human T lymphocytes  
 JOURNAL J. Immunol. 143 (9), 2907-2916 (1989)



MEDLINE 90038522

## FEATURES

source

## Location/Qualifiers

1..520

/organism="Homo sapiens"

/db\_xref="taxon:9606"

/cell\_type="T-cell"

/germline

/map="17"

mRNA

&lt;1..520

/gene="SCYA1"

/note="G00-118-872"

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1..520

/gene="SCYA1"

CDS

51..341

/gene="SCYA1"

/codon\_start=1

/db\_xref="GDB:G00-118-872"

/product="secreted protein I-309"

/db\_xref="PID:g339729"

/translation="MQIITLALVCLLLAGMWPEVDVSKSMQVPFSSRCCFSFAEQEIPL  
RAILCYRNTSSICSNEGLIFKLKRGKEACALDTVGWVQRHRKMLRHCPKSRK"

BASE COUNT

140 a 137 c 122 g 121 t

ORIGIN

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1 accaggctca tcaaagctgc tccaggaagg cccaagccag accagaagac atgcagatca
61 tcaccacagc cctgggtgtgc ttgctgctag ctgggatgtg gccggaagat gtggacagca
121 agagcatgca ggtacccttc tccagatgtt gcttctcatt tgcggagcaa gagattcccc
181 tgagggcaat cctgtgttac agaaatacca gctccatctg ctccaatgag ggcttaatat
241 tcaagctgaa gagaggcaaa gaggcctgcg ccttggacac agttggatgg gttcagaggg
301 acagaaaaat gctgaggcac tgcccgtaaa aaagaaaatg agcagatttc tttccattgt
361 gggctctgga aaccacatgg cttcacctgt ccccgaaact accagcccta caccattcct
421 tctgccctgc ttttgctagg tcacagagga tctgcttggt cttgataagc tatgttggtg
481 cactttaaac atttaaatca tacaatcatc aacccccaac

```

//

LOCUS

AB000887

687 bp mRNA

PRI

05-JUN-1997

DEFINITION

Human mRNA for EBI1-ligand chemokine, complete cds.

ACCESSION

AB000887

NID

g2189952

KEYWORDS

EBI1-ligand chemokine; ELC.

SOURCE

Homo sapiens fetal tissue\_lib:lung cDNA to mRNA.

ORGANISM

Homo sapiens

Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;  
Vertebrata; Mammalia; Eutheria; Primates; Catarrhini;

Hominidae;

Homo.

REFERENCE

1 (bases 1 to 687)

AUTHORS

Yoshida,R., Imai,T., Hieshima,K., Kusuda,J., Baba,M.,

Kitaura,M.,

Nishimura,M., Kakizaki,M., Nomiyama,H. and Yoshie,O.

TITLE

Direct Submission

JOURNAL

Submitted (05-FEB-1997) to the DDBJ/EMBL/GenBank databases.  
Hisayuki Nomiyama, Kumamoto University Medical School,

Department

of Biochemistry; Honjo 2-2-1, Kumamoto, Kumamoto 860, Japan  
(E-mail:nomiyama@gpo.kumamoto-u.ac.jp, Tel:+81-96-373-5063)

REFERENCE

2 (sites)

AUTHORS

Yoshida,R., Imai,T., Hieshima,K., Kusuda,J., Baba,M.,

Kitaura,M.,

Nishimura,M., Kakizaki,M., Nomiyama,H. and Yoshie,O.

TITLE

Molecular cloning of a novel human CC chemokine EBI1-ligand  
chemokine that is a specific functional ligand for EBI1, CCR7

JOURNAL

J. Biol. Chem. 272 (21), 13803-13809 (1997)

MEDLINE

97298088

## FEATURES

source

## Location/Qualifiers

1..687

/organism="Homo sapiens"

/db\_xref="taxon:9606"

/dev\_stage="fetal"

/tissue\_lib="lung"

gene

139..435

/gene="ELC"

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CDS          139..435
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              /note="CC chemokine"
              /codon_start=1
              /product="EBI1-ligand chemokine"
              /db_xref="PID:d1021215"
              /db_xref="PID:g2189953"

/translation="MALLLALSLLVLWTSPAPTLSGTNDACCLSVTQKPIPGYIVR
NFHYLLIKDGCRVPAVVFTTLRGRQLCAPDPQWVERIIQRLQRTSAKMKRRSS"
  mat_peptide 202..432
                /gene="ELC"
                /product="EBI1-ligand chemokine"
  polyA_signal 657..662
BASE COUNT    154 a    223 c    173 g    137 t
ORIGIN
    1 cattccccagc ctcacatcac tcacaccttg catttcaccc ctgcatccca gtcgccctgc
   61 agcctcacac agatcctgca cacacccaga cagctggcgc tcacacattc accgttggcc
  121 tgcctctgtt caccctccat ggccctgcta ctggccctca gctgtgtggt tctctggact
  181 tccccagccc caactctgag tggcaccaat gatgctgaag actgtgtgct gtctgtgacc
  241 cagaaaccca tccctgggta catcgtgagg aacttccact accttctcat caaggatggc
  301 tgcaggggtgc ctgctgtagt gttcaccaca ctgagggggc gccagctctg tgcaccccca
  361 gaccagccct gggtagaacg catcatccag agactgcaga ggacctcagc caagatgaag
  421 cgccgcagca gttaacctat gaccgtgcag agggagcccg gagtccgagt caagcattgt
  481 gaattattac ctaacctggg gaaccgagga ccagaaggaa ggaccaggct tccagctcct
  541 ctgcaccaga cctgaccagc caggacaggg cctgggggtgt gtgtgagtgt gagtgtgagc
  601 gagaggggtga gtgtgggtcag agtaaagctg ctccaccccc agattgcaat gctaccaata
  661 aagccgcctg gtgtttacaa ctaattg

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LOCUS       AB000221      760 bp      mRNA                      PRI      31-JUL-1997
DEFINITION  Homo sapiens mRNA for CC chemokine, complete cds.
ACCESSION   AB000221
NID         g2289718
KEYWORDS    CC chemokine; PARC; pulmonary and activation-regulated
            chemokine.
SOURCE      Homo sapiens lung cDNA to mRNA.
  ORGANISM  Homo sapiens
            Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;
            Vertebrata; Mammalia; Eutheria; Primates; Catarrhini;
Hominidae; Homo.
REFERENCE   1 (bases 1 to 760)
  AUTHORS   Nomiya, H.
  TITLE     Direct Submission
  JOURNAL   Submitted (04-JAN-1997) to the DDBJ/EMBL/GenBank databases.
            Hisayuki Nomiya, Kumamoto University Medical School,
Department of Biochemistry; Honjo 2-2-1, Kumamoto, Kumamoto 860, Japan
            (E-mail:nomiyama@gpo.kumamoto-u.ac.jp, Tel:81-96-373-5063,
            Fax:81-96-372-6140)
REFERENCE   2 (sites)
  AUTHORS   Hieshima, K., Imai, T., Baba, M., Shoudai, K., Ishizuka, K.,
            Nakagawa, T., Tsuruta, J., Takeya, M., Sakaki, Y., Takatsuki, K.,
            Miura, R., Opdenakker, G., Damme, J., Yoshie, O. and Nomiya, H.
  TITLE     A novel human CC chemokine PARC that is most homologous to
            macrophage-inflammatory protein-1alpha/LD78alpha and
chemotactic for T lymphocytes, but not for monocytes
  JOURNAL   J. Immunol. 159 (3), 1140-1149 (1997)
  MEDLINE   97376836
FEATURES    Location/Qualifiers
            source          1..760
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                              /db_xref="taxon:9606"
                              /tissue_type="lung"
            gene            64..333
                              /gene="PARC"
            CDS              64..333
                              /gene="PARC"
                              /note="pulmonary and activation-regulated chemokine"

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/codon\_start=1  
 /product="CC chemokine"  
 /db\_xref="PID:d1022520"  
 /db\_xref="PID:g2289719"

/translation="MKGLAAALLVLVCTMALCSCAQVGTNKELCCLVYTSWQIPQKFI  
 VDYSETSPQCPKPGVILLTKRGRQICADPNKKWVQKYISDLKLNA"

BASE COUNT 186 a 208 c 155 g 211 t

ORIGIN  
 1 gccaggagtt gtgagtttcc aagccccagc tcactctgac cacttctctg cctgcccagc  
 61 atcatgaagg gccttgacgc tgccctcctt gtcctcgtct gcaccatggc cctctgctcc  
 121 tgtgcacaag ttggtaccaa caaagagctc tgctgcctcg tctatacctc ctggcagatt  
 181 ccacaaaagt tcatagttga ctattctgaa accagcccc agtgcccaa gccagggtgc  
 241 atcctcctaa ccaagagagg ccggcagatc tgtgctgacc ccaataagaa gtgggtccag  
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 LOCUS D86955 799 bp mRNA PRI 06-MAR-1997  
 DEFINITION Human mRNA for CC chemokine LARC precursor, complete cds.  
 ACCESSION D86955  
 NID g1871138  
 KEYWORDS CC chemokine LARC precursor.  
 SOURCE Homo sapiens cDNA to mRNA.  
 ORGANISM Homo sapiens  
 Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;  
 Vertebrata; Mammalia; Eutheria; Primates; Catarrhini;  
 Hominidae;  
 Homo.  
 REFERENCE 1 (sites)  
 AUTHORS Hieshima,K., Imai,T., Opdenakker,G., Van Damme,J., Kusuda,J.,  
 Tei,H., Sakaki,Y., Takatsuki,K., Miura,R., Yoshie,O. and  
 Nomiyama,H.  
 TITLE Molecular cloning of a novel human CC chemokine liver and  
 activation-regulated chemokine (LARC) expressed in liver.  
 Chemotactic activity for lymphocytes and gene localization on  
 chromosome 2  
 JOURNAL J. Biol. Chem. 272 (9), 5846-5853 (1997)  
 MEDLINE 97190319  
 REFERENCE 2 (bases 1 to 799)  
 AUTHORS Hieshima,K., Imai,T., Opdenakker,G., Van Damme,J., Kusuda,J.,  
 Tei,H., Sakaki,Y., Takatsuki,K., Miura,R., Yoshie,O. and  
 Nomiyama,H.  
 JOURNAL Unpublished (1996)  
 REFERENCE 3 (bases 1 to 799)  
 AUTHORS Nomiyama,H.  
 TITLE Direct Submission  
 JOURNAL Submitted (08-AUG-1996) to the DDBJ/EMBL/GenBank databases.  
 Hisayuki Nomiyama, Kumamoto University Medical School,  
 Department of Biochemistry; Honjo 2-2-1, Kumamoto, Kumamoto 860, Japan  
 (E-mail:nomiyama@gpo.kumamoto-u.ac.jp, Tel:+81-96-373-5063)  
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LOCUS          HUMAR          538 bp    mRNA          PRI          11-SEP-1996
DEFINITION     Human mRNA for chemokine, complete cds.
ACCESSION      D43767
NID            g1536878
KEYWORDS       chemokine, thymus and activation-regulated; chemokine.
SOURCE         Homo sapiens male peripheral blood cDNA to mRNA, clone:D3A.
ORGANISM       Homo sapiens
                Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;
                Vertebrata; Mammalia; Eutheria; Primates; Catarrhini;
                Hominidae;
                Homo.
REFERENCE      1 (sites)
AUTHORS        Imai,T., Yoshida,T., Baba,M., Nishimura,M., Kakizaki,M. and
                Yoshie,O.
TITLE          Molecular cloning of a novel T cell-directed CC chemokine
expressed      in thymus by signal sequence trap using Epstein-Barr virus
vector
JOURNAL        J. Biol. Chem. 271 (35), 21514-21521 (1996)
MEDLINE        96355526
REFERENCE      2 (bases 1 to 538)
AUTHORS        Imai,T.
JOURNAL        Unpublished (1996)
REFERENCE      3 (bases 1 to 538)
AUTHORS        Imai,T.
TITLE          Direct Submission
JOURNAL        Submitted (07-DEC-1994) to the DDBJ/EMBL/GenBank databases.
Toshio
                Imai, Shionogi Institute for Medical Science; 2-5-1 Mishima,
                Settsu, Osaka 566, Japan (Tel:06-382-2612, Fax:06-382-2598)
FEATURES
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 361 actgtctccc gggactacct gggacctcca ccgttggtgt tcaccgcccc caccctgagc  
 421 gcctgggtcc aggggaggcc ttccaggagc gaagaagagc cacagtgagg gagatcccat  
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LOCUS HUMEOTAXIN 807 bp mRNA PRI 25-SEP-1996  
 DEFINITION Human mRNA for eotaxin, complete cds.  
 ACCESSION D49372  
 NID g1552240  
 KEYWORDS eotaxin; eosinophil-selective CC chemokine; chemoattractant.  
 SOURCE Homo sapiens Small intestine, proximal cDNA to mRNA, clone:141.  
 ORGANISM Homo sapiens  
 Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;  
 Vertebrata; Mammalia; Eutheria; Primates; Catarrhini;  
 Hominidae;  
 Homo.  
 REFERENCE 1 (bases 1 to 807)  
 AUTHORS Kitaura,M., Nakajima,T., Imai,T., Harada,S., Combadiere,C.,  
 Tiffany,H.L., Murphy,P.M. and Yoshie,O.  
 TITLE Molecular cloning of human eotaxin, an eosinophil-selective CC  
 chemokine, and identification of a specific eosinophil eotaxin  
 receptor, CC chemokine receptor 3  
 JOURNAL J. Biol. Chem. 271 (13), 7725-7730 (1996)  
 MEDLINE 96205964  
 REFERENCE 2 (bases 1 to 807)  
 AUTHORS Yoshie,O.  
 TITLE Direct Submission  
 JOURNAL Submitted (15-FEB-1995) to the DDBJ/EMBL/GenBank databases.  
 Osamu  
 Yoshie, Shionogi Institute for Medical Science; 2-5-1 Mishima,  
 Settsu, Osaka 566, Japan (E-mail:osamu.yoshie@shionogi.co.jp,  
 Tel:06-382-2612, Fax:06-382-2598)  
 COMMENT On Sep 20, 1996 this sequence version replaced gi:1313900.  
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DEFINITION H.sapiens mRNA for CC-chemokine.
ACCESSION  Z69291
NID        g1181148
KEYWORDS   CC-chemokine.
SOURCE     human.
ORGANISM   Homo sapiens
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            Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.
REFERENCE  1 (bases 1 to 232)
AUTHORS    Bartels,J.H., Schlueter,C., Richter,E., Christophers,E. and
            Schroeder,J.M.
TITLE      Cloning of a novel human chemokine homologous to human monocyte
            chemoattractant proteins and rodent eotaxins
JOURNAL    Unpublished
REFERENCE  2 (bases 1 to 232)
AUTHORS    Bartels,J.H.
TITLE      Direct Submission
JOURNAL    Submitted (01-FEB-1996) Bartels J. H.,
            Christian-Albrechts-Universitaet zu Kiel,
            Dermatology/Hautklinik,
            Mol.Biol.Lab.609, Schittenhelmstr. 7, Kiel, Schleswig-Holstein,
            Germany, D-24105
REFERENCE  3 (bases 1 to 232)
AUTHORS    Bartels,J., Schluter,C., Richter,E., Noso,N., Kulke,R.,
            Christophers,E. and Schroder,J.M.
TITLE      Human dermal fibroblasts express eotaxin: molecular cloning,
mRNA       expression, and identification of eotaxin sequence variants
JOURNAL    Biochem. Biophys. Res. Commun. 225 (3), 1045-1051 (1996)
MEDLINE    96374440
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DEFINITION H.sapiens gene for chemokine HCC-1.
ACCESSION  249269
NID        g1004266
KEYWORDS   chemokine.
SOURCE     human.
ORGANISM   Homo sapiens
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            Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.
REFERENCE  1 (bases 1 to 4037)
AUTHORS    Pardigol,A., Maegert,H.J., Cieslak,A., Hill,O., Schulz-
            Knappe, P.
            and Forssmann,W.G.
TITLE      Nucleotide Sequence of the Gene for the Human Chemokine HCC-1
JOURNAL    Unpublished
REFERENCE  2 (bases 1 to 4037)
AUTHORS    Pardigol,A.
TITLE      Direct Submission
JOURNAL    Submitted (18-MAY-1995) Andreas Pardigol, Molecular Biology,
            Lower
            Saxony Institute for Peptide Research, Feodor-Lynen-Strasse 31,
            Hannover, Lower Saxon, 30625, Germany
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LOCUS      HSCC21      925 bp      mRNA      PRI      30-JUN-1998
DEFINITION H.sapiens mRNA for chemokine CC-2 and CC-1.
ACCESSION  Z70292
NID        g1296608
KEYWORDS   chemokine CC-1; chemokine CC-2.
SOURCE     human.
ORGANISM   Homo sapiens
            Eukaryota; Metazoa; Chordata; Vertebrata; Mammalia; Eutheria;
            Primates; Catarrhini; Hominidae; Homo.
REFERENCE  1 (bases 1 to 925)

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AUTHORS Pardigol,A., Forssmann,U., Zucht,H.D., Loetscher,P.,  
 Schulz-Knappe,P., Baggiolini,M., Forssmann,W.G. and Magert,H.J.  
 TITLE HCC-2, a human chemokine: gene structure, expression pattern,  
 and biological activity  
 JOURNAL Proc. Natl. Acad. Sci. U.S.A. 95 (11), 6308-6313. (1998)  
 MEDLINE 98263352  
 REFERENCE 2 (bases 1 to 925)  
 AUTHORS Pardigol,A.  
 TITLE Direct Submission  
 JOURNAL Submitted (25-MAR-1996) Andreas Pardigol, IV - Molecular  
 Biology, Lower Saxony Institute for Peptide Research, Feodor-Lynen-  
 Strasse 31, Hannover, Lower Saxony, 30625, Germany  
 FEATURES Location/Qualifiers  
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 /dev\_stage="adult"  
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 CDS 499..780  
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 polyA\_signal 902..908  
 BASE COUNT 240 a 296 c 199 g 190 t  
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 121 gttcaciaat gatgcagaga cagagttaat gatgtcaaag cttccactgg aaaatccagt  
 181 agttctgaac agctttcact ttgctgctga ctgctgcacc tcctacatct caciaagcat  
 241 cccgtgttca ctcataaaaa gttattttga aacgagcagc gagtgctcca agccaggtgt  
 301 catattcctc accaagaagg ggccggcaagt ctgtgccaaa cccagtgggc cgggagttca  
 361 ggattgcatg aaaaagctga agccctactc aatataataa taaagagaca aaagaggcca  
 421 gccacccacc tccaacacct cctgagcctc tgaagctccc accaggccag ctctcctccc  
 481 acaacagctt cccacagcat gaagatctcc gtggctgcca ttcccttctt cctcctcatc  
 541 accatcgccc tagggaccaa gactgaatcc tcctcacggg gaccttacca cccctcagag  
 601 tgctgcttca cctacactac ctacaagatc ccgcgtcagc ggattatgga ttactatgag  
 661 accaacagcc agtgctccaa gcccggaatt gtcttcatca ccaaaagggg ccattccgct  
 721 tgtaccaacc ccagtgaaca gtgggtccag gactatatca aggacatgaa ggagaactga  
 781 gtgacccaga aggggtggcg aaggcacagc tcagagacat aaagagaaga tgccaaggcc  
 841 ccctcctcca cccaccgcta actctcagcc ccagtcaccc tcttgagct tccctgcttt  
 901 gaattaaaga ccactcatgc tcttc

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LOCUS HSCC23 973 bp RNA PRI 03-MAY-1996  
 DEFINITION H.sapiens mRNA for chemokine CC-2 and CC-3.  
 ACCESSION Z70293  
 NID g1296611  
 KEYWORDS Human chemokine CC-2; Human chemokine CC-3.  
 SOURCE human.  
 ORGANISM Homo sapiens  
 Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;  
 Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.  
 REFERENCE 1 (bases 1 to 973)  
 AUTHORS Pardigol, A., Maegert, H.J., Zucht, HD., Forssmann, W.G. and  
 Schulz-Knappe, P.  
 TITLE Transcription of a Human Tandem Gene results in a Mature  
 Bicistronic mRNA encoding two Novel CC-Chemokines  
 JOURNAL Unpublished  
 REFERENCE 2 (bases 1 to 973)  
 AUTHORS Pardigol, A.  
 TITLE Direct Submission  
 JOURNAL Submitted (25-MAR-1996) Andreas Pardigol, IV - Molecular  
 Biology,  
 Strasse Lower Saxony Institute for Peptide Research, Feodor-Lynen-  
 31, Hannover, Lower Saxony, 30625, Germany  
 FEATURES  
 source Location/Qualifiers  
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 CDS 56..397  
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 /db\_xref="PID:g1296612"  
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 DCMKKLKPYSI"  
 misc\_feature 398..498  
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 CDS 499..828  
 /note="putative"  
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 /product="chemokine CC-3"  
 /db\_xref="PID:e233858"  
 /db\_xref="PID:g1296613"  
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 3'UTR 829..973  
 polyA\_signal 950..956  
 BASE COUNT 257 a 301 c 215 g 200 t  
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 1 ccaggaagca gtagagccag gagtcctcgg ccagccctgc ctgcccacca ggaggatgaa  
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 121 gttcacaat gatgcagaga cagagttaat gatgtcaaag ctccactgg aaaatccagt  
 181 agttctgaac agctttcact ttgctgctga ctgctgcacc tcctacatct cacaagcat  
 241 cccgtgttca ctcataaaaa gttattttga aacgagcagc gagtgctcca agccaggtgt  
 301 catattcctc accaagaagg ggcggcaagt ctgtgccaaa cccagtggtc cgggagttca  
 361 ggattgcatg aaaaagctga agccctactc aatataataa taaagagaca aaagaggcca  
 421 gccaccacc tccaacacct cctgagcctc tgaagctccc accaggccag ctctcctccc



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481 acaacagctt cccacagcat gaagatctcc gtggctgcca ttcccttctt cctcctcatc
541 accatcgccc tagggaccaa gactgaatcc tcctcacaaa ctggggggaa accgaagggt
601 gttaaaatac agctaaagtt ggtgggggga ccttaccacc cctcagagtg ctgcttcacc
661 tacactacct acaagatccc gcgtcagcgg attatggatt actatgagac caacagccag
721 tgctccaagc ccggaattgt cttcatcacc aaaaggggcc attccgtctg taccaacccc
781 agtgacaagt gggtcagga ctatatcaag gacatgaagg agaactgagt gaccagaag
841 gggtagcgaa ggcacagctc agagacataa agagaagatg ccaaggcccc ctcctccacc
901 caccgctaac tctcagcccc agtcaccctc ttggagcttc cctgctttga attaaagacc
961 actcatgctc ttc

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LOCUS      HSU91746      .1430 bp      mRNA      PRI      12-MAR-1998
DEFINITION Homo sapiens IL-10-inducible chemokine (HCC-4) mRNA, complete
            cds.
ACCESSION  U91746
NID        g2581780
KEYWORDS
SOURCE     human.
ORGANISM   Homo sapiens
            Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;
            Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.
REFERENCE  1 (bases 1 to 1430)
AUTHORS    Hedrick,J.A., Helms,A., Gorman,D. and Zlotnik,A.
TITLE      Identification of a novel human CC chemokine upregulated by IL-
10
JOURNAL    Blood (1998) In press
REFERENCE  2 (bases 1 to 1430)
AUTHORS    Hedrick,J.A., Helms,A., Gorman,D. and Zlotnik,A.
TITLE      Direct Submission
JOURNAL    Submitted (02-MAR-1997) Immunology, DNAX Research Institute,
901        California Ave, Palo Alto, CA 94304, USA
FEATURES   Location/Qualifiers
            source          1..1430
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            CDS              1..363
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                           /product="IL-10-inducible chemokine"
                           /db_xref="PID:g2581781"

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/translation="MKVSEAALSLVLILIITSASRSQPKVPEWVNTPTCCLKYYEK

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TVKIITAKNGQPQLLSQ"

BASE COUNT 401 a 351 c 293 g 385 t

ORIGIN

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1 atgaaggtct ccgaggtctc cctgtctctc cttgtcctca tccttatcat tacttcggct
61 tctcgcagcc agccaaaagt tcctgagtgg gtgaacaccc catccacctg ctgcctgaag
121 tattatgaga aagtgttgcc aaggagacta gtggtaggat acagaaaggc cctcaactgt
181 cactgcccag caatcatctt cgtcaccaag aggaaccgag aagtctgcac caaccccaat
241 gacgactggg tccaagagta catcaaggat cccaacctac ctttgctgcc taccaggaac
301 ttgtccacgg ttaaaattat tacagcaaag aatgggtcaac cccagctcct caactcccag
361 tgatgaccag gctttagtgg aagcccttgt ttacagaaga gaggggtaaa cctatgaaaa
421 caggggaagc cttattaggc tgaaactagc cagtcacatt gagagaagca gaacaatgat
481 caaaataaag gagaagtatt tcgaatattt tctcaatctt aggaggaaat accaaagtta
541 agggacgtgg gcagaggtac gctcttttat ttttatattt atatttttat ttttttgaga
601 taggtcttac tctgtcaccc aggctggagt gcagtgggtg gatcttggct cacttgatct
661 tggtcactg taacctccac ctcccaggct caagtgatcc tcccaccca gcctcccag
721 tagctgggac tacaggttg cgccaccaca cctggctaata ttttgattt ttggtagaga
781 cggtgattcta ccatgttgcc caggctggtc tcaaactcgt gtgcccagc aatccacctg
841 cctcagcctt ccaaaagtgc tgggattaca ggcgtgagcc accacatccg gccagtgcac
901 tcttaataca cagaaaaata tatttcacat cttctctctg ctctctttca attcctcact
961 tcacaccagt acacaagcca ttctaaatac ttagccagtt tccagccttc cagatgatct
1021 ttgccctctg ggtcttgacc cattaagagc ccatagaac tcttgatttt tcctgtccat
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1141 tttttcatag gaagtccgga tgggaatatt cacattaatc atttttgcag agactttgct
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1261 aaaaaaaaaa aaagagagag agagagaaga agaagaagaa gagacacaaa tctctacctc
1321 ccatgttaag ctttgcagga cagggaaaga aagggtatga gacacggcta ggggtaaact
1381 cttagtccaa aaccaagca tgcaataaat aaaactcctt tatttgacaa

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LOCUS AB007454 1503 bp mRNA PRI 09-APR-1998  
 DEFINITION Homo sapiens mRNA for chemokine LEC precursor, complete cds.  
 ACCESSION AB007454  
 NID g2723285  
 KEYWORDS chemokine LEC precursor.  
 SOURCE Homo sapiens liver cDNA to mRNA.  
 ORGANISM Homo sapiens  
 Eukaryota; Metazoa; Chordata; Vertebrata; Mammalia; Eutheria;  
 Primates; Catarrhini; Hominidae; Homo.  
 REFERENCE 1 (sites)  
 AUTHORS Shoudai, K., Hieshima, K., Fukuda, S., Iio, M., Miura, R., Imai, T.,  
 Yoshie, O. and Nomiyama, H.  
 TITLE Isolation of cDNA encoding a novel human CC chemokine NCC-4/LEC  
 JOURNAL Biochim. Biophys. Acta 1396 (3), 273-277 (1998)  
 MEDLINE 98207719  
 REFERENCE 2 (bases 1 to 1503)  
 AUTHORS Nomiyama, H.  
 TITLE Direct Submission  
 JOURNAL Submitted (19-SEP-1997) to the DDBJ/EMBL/GenBank databases.  
 Hisayuki Nomiyama, Kumamoto University Medical School,  
 Department of Biochemistry; Honjo 2-2-1, Kumamoto, Kumamoto 860-0811,  
 Japan  
 (E-mail: nomiyama@gpo.kumamoto-u.ac.jp, Tel: 81-96-373-5063,  
 Fax: 81-96-372-6140)  
 FEATURES  
 source Location/Qualifiers  
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 /organism="Homo sapiens"  
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 CDS 77..439  
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 polyA\_signal 560..565  
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 BASE COUNT 417 a 374 c 312 g 400 t  
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181 cacctgctgc ctgaagtatt atgagaaagt gttgccaagg agactagtgg tgggatacag
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901 cccaagcaat ccacctgect cagccttcca aaagtgtctg gattacaggc gtgagccacc
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1261 tttgcagaga ctttgctaga tcctctcata ttttgtcttc ctcagggtgg caggggtaca
1321 gagatgtcct gattggaaaa aaaaaaaaaa gagagagaga gagaagaaga agaagaagag
1381 acacaaatct ctacctcca tgtaagctt tgcaggacag ggaaagaaag ggtatgagac
1441 acggctaggg gtaaactctt agtccaaaac ccaagcatgc aataaataaa actcccttat
1501 ttg

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LOCUS      AF001979      800 bp      mRNA      PRI      20-NOV-1997
DEFINITION Homo sapiens beta chemokine mRNA, complete cds.
ACCESSION  AF001979
NID        g2624924
KEYWORDS
SOURCE     human.
ORGANISM   Homo sapiens
            Eukaryotae; Metazoa; Chordata; Vertebrata; Mammalia; Eutheria;
            Primates; Catarrhini; Hominidae; Homo.
REFERENCE  1 (bases 1 to 800)
AUTHORS    Hedrick, J.A. and Zlotnik, A.
TITLE      Identification and characterization of a novel beta chemokine
            containing six conserved cysteines
JOURNAL     J. Immunol. 159 (4), 1589-1593 (1997)
MEDLINE     97400322
REFERENCE  2 (bases 1 to 800)
AUTHORS    Hedrick, J.A. and Zlotnik, A.
TITLE      Direct Submission
JOURNAL     Submitted (01-MAY-1997) Immunobiology, DNAX Research Institute,
901        California Ave, Palo Alto, CA 94304, USA
FEATURES   Location/Qualifiers
            source          1..800
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                        /db_xref="taxon:9606"
            CDS             1..405
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                        /db_xref="PID:g2624925"

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/translation="MAQSLALSLILVLAFGIPRTQGS DGAQDCCLKYSQRKIPAKV

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CRKDRGASKTGKKGKSGCKRTERSQTPKGP"

BASE COUNT 203 a 248 c 210 g 139 t

ORIGIN

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1 atggctcagt cactggctct gagcctcctt atcctgggtc tggcctttgg aatccccagg
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301 cagggtcga ggaaggacag gggggcctcc aagactggca agaaaggaaa gggctccaaa
361 ggctgcaaga ggactgagcg gtcacagacc cctaaagggc catagcccag tgagcagcct
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541 ctctgcttt aaccaccca tctgcattcc cagctctacc ctgcatggct gagctgcca
601 cagcaggcca ggtccagaga gaccgaggag ggagagtctc ccaggagca tgagaggagg
661 cagcaggact gtccccttga aggagaatca tcaggacctt ggacctgata cggctcccca
721 gtacaccca cctcttcctt gtaaataatga ttataccta actgaataaa aagctgttct
781 gtcttcccac ccaaaaaaaaa

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LOCUS      HSU64197      821 bp      mRNA      PRI      25-JUN-1997
DEFINITION Homo sapiens chemokine exodus-1 mRNA, complete cds.
ACCESSION  U64197
NID        g1778716
KEYWORDS
SOURCE     human.
ORGANISM   Homo sapiens
            Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;

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Hominidae; Vertebrata; Mammalia; Eutheria; Primates; Catarrhini;  
 Homo.  
 REFERENCE 1 (bases 1 to 821)  
 AUTHORS Hromas, R., Gray, P.W., Chantry, D., Godiska, R., Krathwohl, M.,  
 Fife, K., Bell, G.I., Takeda, J., Aronica, S., Gordon, M.,  
 Cooper, S., Broxmeyer, H.E. and Klemsz, M.J.  
 TITLE Cloning and characterization of exodus, a novel beta-chemokine  
 JOURNAL Blood 89 (9), 3315-3322 (1997)  
 MEDLINE 97275143  
 REFERENCE 2 (bases 1 to 821)  
 AUTHORS Hromas, R.A.  
 TITLE Direct Submission  
 JOURNAL Submitted (17-JUL-1996) Indiana University Medical Center,  
 Medicine, 975 W. Walnut St., Indianapolis, IN 46202, USA  
 FEATURES  
 source Location/Qualifiers  
 1..821  
 /organism="Homo sapiens"  
 /db\_xref="taxon:9606"  
 /clone="Exodus-1"  
 /cell\_type="islet"  
 /tissue\_type="pancreas"  
 /dev\_stage="adult"  
 CDS 43..330  
 /function="inhibits proliferation of hematopoietic  
 progenitors and HIV"  
 /codon\_start=1  
 /product="chemokine exodus-1"  
 /db\_xref="PID:g1778717"  
 /translation="MCCTKSLLLAALMSVLLHLGGESEASNFDCCCLGYTDRILHPKF  
 IVGFTRQLANEGCDINAIIFHTKKKLSVCANPKQTWVKYIVRLLSKKVKNM"  
 variation 121^122  
 encoding /note="insertion of an extra codon GCA at nt 121,  
 position for an alanine after the alanine at amino acid  
 transcript 26, represents the allelic difference of the  
 isolated from macrophages"  
 BASE COUNT 258 a 134 c 156 g 273 t  
 ORIGIN  
 1 ggtactcaac actgagcaga tctgttcttt gagctaaaaa ccatgtgctg taccaagagt  
 61 ttgctcctgg ctgctttgat gtcagtgtcg ctactccacc tctgcggcga atcagaagca  
 121 agcaactttg actgctgtct tggatacaca gaccgtattc ttcactcctaa atttattgtg  
 181 ggcttcacac ggcagctggc caatgaaggc tgtgacatca atgctatcat ctttcacaca  
 241 aagaaaaagt tgtctgtgtg cgcaaatcca aaacagactt gggtgaaata tattgtgcgt  
 301 ctcctcagta aaaaagtcaa gaacatgtaa aaactgtggc ttttctggaa tgggaattgga  
 361 catagcccaa gaacagaaag aacctgtctg gggttggagg tttcacttgc acatcatgga  
 421 gggtttagtg cttatctaatt ttgtgcctca cctggacttg tccaattaat gaagttgatt  
 481 catattgcat catagtttgc tttgtttaag catcacatta aagtgaact gtattttatg  
 541 ttatttatag ctgtagggtt tctgtgttta gctatttaac actaattttc cataagctat  
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 661 ttgcaagcaa caagctattt tttaaaaaaa actatttaac attcctttgt ttatattgtt  
 721 ttgtctccta aattgttgta atgtcattat aaaataagaa aaatattaat aagacaaata  
 781 ttgaaaataa agaaacaaaa agtgcttctg ttaaaaaaaa a  
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LOCUS HSU88320 828 bp mRNA PRI 18-DEC-1997  
 DEFINITION Human beta chemokine Exodus-2 mRNA, complete cds.  
 ACCESSION U88320  
 NID g2196919  
 KEYWORDS  
 SOURCE human.  
 ORGANISM Homo sapiens  
 Eukaryotae; Metazoa; Chordata; Vertebrata; Mammalia; Eutheria;  
 Primates; Catarrhini; Hominidae; Homo.  
 REFERENCE 1 (bases 1 to 828)  
 AUTHORS Hromas, R., Kim, C.H., Klemsz, M., Krathwohl, M., Fife, K.,  
 Cooper, S.,



TITLE Schnizlein-Bick, C. and Broxmeyer, H.E.  
 chemokine Isolation and characterization of Exodus-2, a novel C-C  
 with a unique 37-amino acid carboxyl-terminal extension  
 JOURNAL J. Immunol. 159 (6), 2554-2558 (1997)  
 MEDLINE 97444139  
 REFERENCE 2 (bases 1 to 828)  
 AUTHORS Hromas, R.A.  
 TITLE Direct Submission  
 JOURNAL Submitted (04-FEB-1997) Medicine, Indiana University Medical  
 Center, 975 West Walnut, Indianapolis, IN 46202, USA  
 FEATURES Location/Qualifiers  
 source 1..828  
 /organism="Homo sapiens"  
 /note="PCR amplified from activated THP-1 cells"  
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 /clone\_lib="Soares human placenta cDNA"  
 /cell\_line="THP-1"  
 /cell\_type="monoblast"  
 CDS 15..419  
 /codon\_start=1  
 /product="beta chemokine Exodus-2"  
 /db\_xref="PID:g2196920"

/translation="MAQSLALSLLILVLAFGIPRTQGS DGG AQDCCLKYSQRKIPAKV

VRSYRKQEPSLGCSIPAILFLPRKRSQAELCADPKELWVQQLMQHLDKTPSPQKPAQG  
 CRKDRGASKTGKKGKSGKCKRTERSQTPKGP"

BASE COUNT 218 a 255 c 216 g 139 t  
 ORIGIN

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1  ggcaagagggc agacatggct cagtcactgg ctctgagcct ccttatcctg gttctggcct
61  ttggcatccc caggacccaa ggcaagtgat gaggggctca ggactgttgc ctcaagtaca
121  gccaaaggaa gattcccgcc aagggttgct gcagctaccg gaagcaggaa ccaagcttag
181  gctgctccat cccagctatc ctgttcttgc cccgcaagcg ctctcaggca gagctatgtg
241  cagacccaaa ggagctctgg gtgcagcagc tgatgcagca tctggacaag acaccatccc
301  cacagaaacc agcccagggc tgcaggaagg acaggggggc ctccaagact ggcaagaaag
361  gaaagggctc caaaggctgc aagaggactg agcggtcaca gaccctaaa gggccatagc
421  ccagtgagca gcctggagcc ctggagaccc caccagcctc accagcgctt gaagcctgaa
481  cccaagatgc aagaaggagg ctatgctcag gggccctgga gcagccaccc catgctggcc
541  ttgccacact ctttctcctg ctttaaccac cccatctgca ttcccagctc tcaccctgca
601  tggctgagtc tgcccacagc aggccaggtc cagagagacc gaggaggagg agtctcccag
661  ggagcatgag aggaggcagc aggactgtcc ccttgaagga gaatcatcag gaccctggac
721  ctgatacggc tccccagtac accccacctc ttccttgtaa atatgattta tacctaactg
781  aataaaaagc tgttctgtct tcccacccaa aaaaaaaaaa aaaaaaaaaa
  
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LOCUS HSU88321 502 bp mRNA PRI 22-JUN-1998  
 DEFINITION Human beta chemokine Exodus-3 mRNA, complete cds.  
 ACCESSION U88321  
 NID g2196921  
 KEYWORDS .  
 SOURCE human.  
 ORGANISM Homo sapiens  
 Eukaryotae; Metazoa; Chordata; Vertebrata; Mammalia; Eutheria;  
 Primates; Catarrhini; Hominidae; Homo.  
 REFERENCE 1 (bases 1 to 502)  
 AUTHORS Hromas, R.A., Gray, P., Klemsz, M., Fife, K. and Broxmeyer, H.  
 TITLE DCCCL chemokines represent a novel beta chemokine subfamily  
 JOURNAL Unpublished  
 REFERENCE 2 (bases 1 to 502)  
 AUTHORS Hromas, R.A.  
 TITLE Direct Submission  
 JOURNAL Submitted (04-FEB-1997) Medicine, Indiana University Medical  
 Center, 975 West Walnut, Indianapolis, IN 46202, USA  
 REFERENCE 3 (bases 1 to 502)  
 AUTHORS Hromas, R.A.  
 TITLE Direct Submission  
 JOURNAL Submitted (22-JUN-1998) Medicine, Indiana University Medical  
 Center, 975 West Walnut, Indianapolis, IN 46202, USA  
 REMARK Amino acid sequence updated by submitter  
 FEATURES Location/Qualifiers  
 source 1..502



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/organism="Homo sapiens"
/note="PCR amplified from THP-1 cells"
/db_xref="taxon:9606"
/cell_line="THP-1"
/cell_type="monoblast"
/dev_stage="adult"
CDS
120..416
/note="Mip-3alpha/ELC/CKbeta11"
/codon_start=1
/product="beta chemokine Exodus-3"
/db_xref="PID:g3243080"

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/translation="MALLLALSLLVLWTSPAPTLSGTNDACCLSVTQKPIPGYIVR

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BASE COUNT      113 a      170 c      121 g      98 t
ORIGIN

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1 ctcacacctt gcatttcacc cctgcatccc atgcgccttg cagcctcaca cagatcctgc
61 acacacccag acagctggcg ctcacacatt caccgttggc ctgcctctgt tcaccctcca
121 tggccctgct actggccctc agcctgctgg ttctctggac ttccccagcc ccaactctga
181 gtggcaccaa tgatgctgaa gactgctgcc tgtctgtgac ccagaaaccc atccctgggt
241 acatcgtgag gaacttcacc taccttctca tcaaggatgg ctgcagggtg cctgctgtag
301 tgttcaccac actgaggggc cgccagctct gtgcaccccc agaccagccc tgggtagaac
361 gcatcatcca gagactgcag aggacctcag ccaagatgaa gcgccgcagc agttaaccta
421 tgaccgtgca gagggagccc cgagtcagag tcaagcattg tgaattatta ctaactggga
481 acgaggacag aaggaaggac ag

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LOCUS      HSU86358      879 bp      mRNA      PRI      11-SEP-1997
DEFINITION Human chemokine (TECK) mRNA, complete cds.
ACCESSION  U86358
NID        g2388626
KEYWORDS
SOURCE     human.
ORGANISM   Homo sapiens
            Eukaryotae; Metazoa; Chordata; Vertebrata; Mammalia; Eutheria;
            Primates; Catarrhini; Hominidae; Homo.
REFERENCE  1 (bases 1 to 879)
AUTHORS    Vicari,A.P., Figueroa,D.J., Hedrick,J.A., Foster,J.S.,
Singh,K.P.,
and        Menon,S., Copeland,N.G., Gilbert,D.J., Jenkins,N.A., Bacon,K.B.
            Zlotnik,A.
TITLE      TECK: a novel cc chemokine specifically expressed by thymic
            dendritic cells and potentially involved in T cell development
JOURNAL    Immunology 7, 291-301 (1997)
REFERENCE  2 (bases 1 to 879)
AUTHORS    Vicari,A.P. and Zlotnik,A.
TITLE      Direct Submission
JOURNAL    Submitted (21-JAN-1997) Immunology, DNAX Research Institute,
901        California Ave., Palo Alto, CA 94304, USA
FEATURES   Location/Qualifiers
            source      1..879
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                        /db_xref="taxon:9606"
                        /chromosome="4"
                        /tissue_type="thymus"
            gene        1..879
                        /gene="TECK"
            CDS          1..453
                        /gene="TECK"
                        /codon_start=1
                        /product="chemokine"
                        /db_xref="PID:g2388627"

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/translation="MNLWLLACLAVAGFLGAWAPAVHTQGVFEDCCLAYHYPGWAVLR

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RAWTYRIQEVSGSCNLPAAIFYLPKRHRKVCGNPKSREVQRAMKLLDARNKVFAPLHH

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NMQTFQAGPHAVKKLSSGNSKLSSSKFSNPISSSKRNVSLLISANSGL"
BASE COUNT      191 a      264 c      218 g      206 t

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## ORIGIN

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1 atgaacctgt ggctcctggc ctgectggtg gccggcttcc tgggagcctg ggcccccgct
61 gtccacaccc aaggtgtctt tgaggactgc tgcctggcct accactaccc cattgggtgg
121 gctgtgctcc ggcgcgcctg gacttaccgg atccaggagg tgagcgggag ctgcaatctg
181 cctgctgcga tattctacct cccaagaga cacaggaagg tgtgtgggaa ccccaaaagc
241 agggaggtgc agagagccat gaagctcctg gatgctcgaa ataaggtttt tgcaaagctc
301 caccacaaca tgcagacctt ccaagcaggc cctcatgctg taaagaagtt gagttctgga
361 aactccaagt tatcatcatc caagtttagc aatcccatca gcagcagcaa gaggaatgct
421 tccctcctga tatcagctaa ttcaggactg tgagccggct catttctggg ctccatcggc
481 acaggagggg ccggatcttt ctccgataaa accgtcgccc tacagacca gctgtcccca
541 cgcctctgtc ttttgggtca agtcttaatc cctgcacctg agttggctct ccctctgcac
601 ccccaccacc tcctgcccgt ctggcaactg gaaagaagga gttggcctga ttttaacctt
661 ttgccgctcc ggggaacagc acaatectgg gcagccagtg gctctttagt agaaaactta
721 ggatacctct ctcactttct gtttcttgcc gtccaccccg ggccatgcca gtgtgtcctc
781 tgggtccctt ccaaaaatct ggtcattcaa ggatccctc ccaaggctat gcttttctat
841 aacttttaaa taaaccttgg ggggtgaatg gaataaaaa

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LOCUS AB002409 852 bp mRNA PRI 15-AUG-1997

DEFINITION Homo sapiens mRNA for SLC, complete cds.

ACCESSION AB002409

NID g2335034

KEYWORDS SLC; mature ELC.

SOURCE Homo sapiens cDNA to mRNA.

ORGANISM Homo sapiens  
Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;  
Vertebrata; Mammalia; Eutheria; Primates; Catarrhini;

Hominidae; Homo.

REFERENCE 1 (bases 1 to 852)

AUTHORS Nomiya, H.

TITLE Direct Submission

JOURNAL Submitted (28-MAR-1997) to the DDBJ/EMBL/GenBank databases.  
Hisayuki Nomiya, Kumamoto University Medical School,  
Department of Biochemistry; Honjo 2-2-1, Kumamoto, Kumamoto 860, Japan  
(E-mail:nomiyama@gpo.kumamoto-u.ac.jp, Tel:81-96-373-5063,  
Fax:81-96-372-6140)

REFERENCE 2 (bases 1 to 852)

AUTHORS Nagira, M., Imai, T., Hieshima, K., Kusuda, J., Ridanpaa, M.,  
Takagi, S., Nishimura, M., Kakizaki, M., Nomiya, H. and Yoshie, O.

TITLE Molecular Cloning of a Novel Human CC Chemokine Secondary  
Lymphoid-Tissue Chemokine (SLC) That is an Efficient  
Chemoattractant for Lymphocytes and Mapped to Chromosome 9p13

JOURNAL Unpublished (1997)

FEATURES Location/Qualifiers

source 1..852  
/organism="Homo sapiens"  
/db\_xref="taxon:9606"

CDS 59..463  
/codon\_start=1  
/product="SLC"  
/db\_xref="PID:d1022673"  
/db\_xref="PID:g2335035"

/translation="MAQSLALSLLILVLAFGIPRTQGS DGAQDCCLKYSQRKIPAKV  
VRSYRKQEPSLGC SIPAILFLPRKRSQAELCADPKELWVQQLMQHLDKTPSPQKPAQG  
CRKDRGASKTGKKGKSGKCKRTSQT PKGP"

mat\_peptide <107..460  
/product="mature ELC"

polyA\_site 823..828

BASE COUNT 205 a 279 c 217 g 151 t

## ORIGIN

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1 cttgcagctg cccacctcac cctcagctct ggctctttac tcacctcta ccacagacat
61 ggctcagtcg ctggctctga gctctcttat cctgggttctg gcctttggca tccccaggac
121 ccaaggcagt gatggagggg ctccaggactg ttgcctcaag tacagccaaa ggaagattcc
181 cgccaagggt gtccgcagct accggaagca ggaaccaagc ttaggctgct ccatcccagc
241 tatcctgttc ttgccccgca agcgtcttca ggcagagcta tgtgcagacc caaaggagct
301 ctgggtgcag cagctgatgc agcatctgga caagacacca tccccacaga aaccagccca

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361 gggctgcagg aaggacaggg gggcctccaa gactggcaag aaaggaaagg gctccaaagg
421 ctgcaagagg actgagcggc cacagacccc taaagggcc tagccagtg agcagcctgg
481 agccctggag accccaccag cctcaccaac gcttgaagcc tgaacccaag atgcaagaag
541 gaggtatgc tcagggggccc tggagcagcc accccatgct ggccttgcca cactcttctt
601 cctgctttaa ccaccccatc tgcattccca gctctaccct gcatggctga gctgcccaca
661 gcaggccagg tccagagaga ccgaggaggg agagtctccc agggagcatg agaggaggca
721 gcaggactgt ccccttgaag gagaatcatc aggaccctgg acctgatacg gctccccagt
781 acaccccacc tcttccttgt aatatgatt tatacctaac tgaataaaaa gctgttctgt
841 cttcccaccc gc

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LOCUS      AF055467      1481 bp      mRNA
DEFINITION Homo sapiens monotactin-1 mRNA, complete cds.
ACCESSION  AF055467
NID        g3395775
KEYWORDS
SOURCE     human.
ORGANISM   Homo sapiens
            Eukaryota; Metazoa; Chordata; Vertebrata; Mammalia; Eutheria;
            Primates; Catarrhini; Hominidae; Homo.
REFERENCE  1 (bases 1 to 1481)
AUTHORS    Youn,B.S., Zhang,S., Broxmeyer,H.E., Antol,K., Fraser,M.J. Jr.,
            Hangoc,G. and Kwon,B.S.
TITLE      Isolation and characterization of LMC, a novel lymphocyte and
            monocyte chemoattractant human CC chemokine, with
            myelosuppressive activity
JOURNAL     Biochem. Biophys. Res. Commun. 247 (2), 217-222 (1998)
MEDLINE     98308096
REFERENCE  2 (bases 1 to 1481)
AUTHORS     Youn,B.S. and Kwon,B.S.
TITLE      Direct Submission
JOURNAL     Submitted (24-MAR-1998) Microbiology and Immunology, Indiana
            University, School of Medicine, 605 Barnhill Dr. Medical
            Science Bldg., Indianapolis, IN 46202, USA
FEATURES
            Location/Qualifiers
            source          1..1481
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                           /db_xref="taxon:9606"
                           /chromosome="17"
            5'UTR          1..34
            CDS             35..397
                           /note="Mtn-1; LMC; lymphocyte and monocyte
                           CC chemokine"
                           /codon_start=1
                           /product="monotactin-1"
                           /db_xref="PID:g3395776"
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            VLPRLVVGyrKALNCHLPaIIIFVTKRNREVCTNPNDWVQEIYIKDPNLPLLPTRNLS
            TVKIITAKNGQPQLLSQ"
            3'UTR          398..1481
BASE COUNT  412 a      362 c      302 g      405 t
ORIGIN

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1 gcacgagctg aagctgtact gcctcgctga gaggatgaag gtctccgagg ctgccctgtc
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121 gtgggtgaac accccatcca cctgctgcct gaagtattat gagaaagtgt tgccaaggag
181 actagtgggt ggatacagaa aggcctcaa ctgtcacctg ccagcaatca tcttcgtcac
241 caagaggaac cgagaagtct gcaccaaccc caatgacgac tgggtccaag agtacatcaa
301 ggatcccaac ctacctttgc tgcctaccag gaacttgctc acggttaaaa ttattacagc
361 aaagaatggt caaccccagc tcctcaactc ccagtgatga ccaagcttta gtggaagccc
421 ttgtttacag aagagagggg taaactatga aaacagggga agccttatta ggctgaaact
481 agccagtcac attgagagaa gcagaacaat gatcaaaata aaggagaagt atttcgaata
541 ttttctcaat cttaggagga aataccaaag ttaagggagc tgggcagagg tacgctcttc
601 tatttttata tttatatatt tttttttttg agataggggc ttactctgtc acccaggctg
661 gagtgcagtg gtgtgatctt ggctcacttg atcttggtc actgtaacct ccacctccca
721 ggctcaagtg atcctccac cccaccctcc cgagtagctg ggactacagg cttgcgccac
781 cacacctggc taatttttgt atttttggtg gagacgggat tctaccatgt tgcccaggct

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841 ggtctcaaac tcgtgtgccc aagcaatcca cctgcctcag ccttccaaaa gtgctgggct
901 tacaggcgtg agccaccaca tccggccagt ccactcttaa tacacagaaa aatatatttc
961 acatccttct cctgctctct ttcaattcct cacttcacac cagtacacaa gccattctaa
1021 atacttagcc agtttccagc cttccagatg atctttgccc tctgggtctt gaccatttaa
1081 gagccccata gaactcttga tttttcctgt ccactcttat gggatttttc tggatctata
1141 ttttcttcaa ttattctttc attttataat gcaacttttt cataggaagt ccggtaggga
1201 atattcacat taatcatttt tgcagagact ttgctagatc ctctcatatt ttgtcttctt
1261 caggggtggc ggggtacaga agtgcctgat tggttttttt tttttttgag agagagagag
1321 aagaagaaga agaagagaca caaatctcta cctcccatgt taagctttgc aggacaggga
1381 aagaaagggt atgagacacg gctagggtaa actcttagtc caaaaccaa gcatgcaata
1441 aataaaactc ccttatttga caaaaaaaaa aaaaaaaaaa a

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LOCUS      HSRNAATAC      557 bp      RNA      PRI      06-JUL-1995
DEFINITION H.sapiens mRNA for ATAC protein.
ACCESSION  X86474
NID        g895846
KEYWORDS   ATAC gene.
SOURCE     human.
ORGANISM   Homo sapiens
            Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;
            Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.
REFERENCE  1 (bases 1 to 557)
AUTHORS    Muller,S., Dorner,B., Korthauer,U., Mages,H.W., D'Apuzzo,M.,
            Senger,G. and KroczeK,R.A.
TITLE      Cloning of ATAC, an activation-induced, chemokine-related
molecule  exclusively expressed in CD8+ T lymphocytes
            Eur. J. Immunol. 25 (6), 1744-1748 (1995)
JOURNAL     95339892
MEDLINE     2 (bases 1 to 557)
REFERENCE   KroczeK,R.A.
AUTHORS     Direct Submission
TITLE       Submitted (20-APR-1995) R.A. KroczeK, Molecular Immunology,
JOURNAL     Robert-Koch-Institute, Nordufer 20, 13353 Berlin, FRG

FEATURES
source      Location/Qualifiers
            1..557
            /organism="Homo sapiens"
            /db_xref="taxon:9606"
            /tissue_type="peripheral blood"
            /cell_type="lymphocyte"
            /chromosome="1"
            /map="q23"
gene        25..369
            /gene="ATAC"
CDS         25..369
            /gene="ATAC"
            /codon_start=1
            /product="CD8+T cell specific protein"
            /db_xref="PID:g895847"
            /db_xref="SWISS-PROT:P47992"

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/translation="MRLILALLGICSLTAYIVEGVGSEVSDKRTCVSLLTQRLPVSR

IKTYTITEGSLRAVIFITKRLKVCADPQATWVRDVVRSMRKSNTNRNMIQTKPTGT  
QSTNTAVTLTG"

polyA\_signal 469..474

polyA\_signal 534..539

BASE COUNT 157 a 139 c 112 g 149 t

ORIGIN

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1 gcacagctca gcaggacctc agccatgaga cttctcatcc tggccctcct tggcatctgc
61 tctctcactg catacattgt ggaagggtga gggagtgaag tctcagataa gaggacctgt
121 gtgagcctca ctaccacagc actgccggtt agcagaatca agacctacac catcacggaa
181 ggctccttga gagcagtaat ttttattacc aaacgtggcc taaaagtctg tgctgatcca
241 caagccacat ggggtgagaga cgtgggtcagg agcatggaca ggaaatccaa caccagaaat
301 aacatgatcc agaccaagcc aacaggaacc cagcaatcga ccaatacagc tgtgactctg
361 actggctagt agtctctggc accctgtccg tctccagcca gccagctcat ttcactttac
421 acgctcatgg actgagttta tactgcctt ttatgaaagc actgcatgaa taaaattatt
481 cctttgtatt tttactttta aatgtcttct gtattcactt atatgttcta attaataaat
541 tatttattat taagaat

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LOCUS HSU85767 563 bp mRNA PRI 01-APR-1997  
 DEFINITION Human myeloid progenitor inhibitory factor-1 MPIF-1 mRNA,  
 complete cds.  
 ACCESSION U85767  
 NID g1916249  
 KEYWORDS  
 SOURCE human.  
 ORGANISM Homo sapiens  
 Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;  
 Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.  
 REFERENCE 1 (bases 1 to 563)  
 AUTHORS Patel,V.P., Kreider,B.L., Li,Y., Li,H., Leung,K., Salcedo,T.,  
 Nardelli,B., Pippalla,V., Gentz,S., Thotakura,R., Parmelee,D.,  
 Gentz,R. and Garotta,G.  
 TITLE Molecular and functional characterization of two novel human C-  
 chemokines as inhibitors of two distinct classes of myeloid  
 progenitors  
 JOURNAL J. Exp. Med. (1997) In press  
 REFERENCE 2 (bases 1 to 563)  
 AUTHORS Li,H. and Patel,V.P.  
 TITLE Direct Submission  
 JOURNAL Submitted (17-JAN-1997) Cell Biology, Human Genome Sciences,  
 9410 Keywest Ave., Rockville, MD 20850, USA  
 FEATURES Location/Qualifiers  
 source 1..563  
 /organism="Homo sapiens"  
 /db\_xref="taxon:9606"  
 CDS 31..393  
 /note="myeloid progenitor inhibitory factor-1"  
 /codon\_start=1  
 /product="MPIF-1"  
 /db\_xref="PID:g1916250"

/translation="MKVSVAALSCLMLVTALGSQARVTKDAETEFMMSKLPLENPVLL

DRFHATSADCCISYTPRSIPCSLLESYFETNSECSKPGVIFLTKKGRRFCANPSDKQV  
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BASE COUNT 164 a 143 c 117 g 139 t  
 ORIGIN

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1 ctcagccagc cctgcctgcc caccaggagg atgaaggtct ccgtgggtgc cctctcctgc
61 ctcattgctt ttactgccct tggatcccag gcccgggtca caaaagatgc agagacagag
121 ttcatgatgt caaagcttcc attggaaaat ccagtacttc tggacagatt ccatgctact
181 agtgctgact gctgcatctc ctacacccca cgaagcatcc cgtgttcact cctggagagt
241 tactttgaaa cgaacagcga gtgctccaag ccgggtgtca tcttcctcac caagaagggg
301 cgacgtttct gtgccaaccc cagtataag caagttcagg tttgcatgag aatgctgaag
361 ctggacacac ggatcaagac caggaagaat tgaacttgtc aaggtgaagg gacacaagtt
421 gccagccacc aactttcttg cctcaactac ctctctgaat tattttttta agaagcattt
481 attcttgtgt tctggattta gagcaattca tctaataaac agtttctcac ttttaaaaaa
541 aaaaaaaaaa aaaaaaaaaa aaa

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//

LOCUS HSU85768 360 bp mRNA PRI 01-APR-1997  
 DEFINITION Human myeloid progenitor inhibitory factor-1 MPIF-2 mRNA,  
 complete cds.  
 ACCESSION U85768  
 NID g1916251  
 KEYWORDS  
 SOURCE human.  
 ORGANISM Homo sapiens  
 Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;  
 Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.  
 REFERENCE 1 (bases 1 to 360)  
 AUTHORS Patel,V.P., Kreider,B.L., Li,Y., Li,H., Leung,K., Salcedo,T.,  
 Nardelli,B., Pippalla,V., Gentz,S., Thotakura,R., Parmelee,D.,  
 Gentz,R. and Garotta,G.  
 TITLE Molecular and functional characterization of two novel human C-



C

chemokines as inhibitors of two distinct classes of myeloid progenitors

J. Exp. Med. (1997) In press

2 (bases 1 to 360)

Li, H. and Patel, V. P.

Direct Submission

Submitted (17-JAN-1997) Cell Biology, Human Genome Sciences, 9410 Keywest Ave., Rockville, MD 20850, USA

Location/Qualifiers

1..360

/organism="Homo sapiens"

/db\_xref="taxon:9606"

1..360

/note="myeloid progenitor inhibitory factor-2"

/codon\_start=1

/product="MPIF-2"

/db\_xref="PID:g1916252"

/translation="MAGLMTIVTSLFLGVCAHHIPTGSVVIPSPCCMFFVSKRIPE

NRVVSQYLSSRSTCLKGGVIFTTKKGQQFCGDPKQEWVQRYMKNLDAKQKKASPRARA

VAVKGPVQRYPGNQTTTC"

BASE COUNT 85 a 106 c 96 g 73 t

ORIGIN

1 atggcaggcc tgatgaccat agtaaccagc cttctgttcc ttggtgtctg tgcccaccac

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241 tgggtccaga ggtacatgaa gaacctggac gcccaagcaga agaaggcttc ccctagggcc

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LOCUS HUMSDF1A 1847 bp mRNA PRI 26-DEC-1996

DEFINITION Human pre-B cell stimulating factor homologue (SDF1a) mRNA, complete cds.

ACCESSION L36034

NID g1220363

KEYWORDS intercrine; intercrine CXC subfamily; pre-B cell stimulating factor

homologue; alpha-chemokine.

SOURCE human.

ORGANISM Homo sapiens

Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata; Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.

REFERENCE 1 (bases 1 to 1847)

AUTHORS Shirozu, M., Nakano, T., Inazawa, J., Tashiro, K., Tada, H., Shinohara, T. and Honjo, T.

TITLE Structure and chromosomal localization of the human stromal cell-derived factor 1 (SDF1) gene

JOURNAL Genomics 28 (3), 495-500 (1995)

MEDLINE 96039262

Location/Qualifiers

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LOCUS HUMSDF1B 3524 bp mRNA PRI 26-DEC-1996

DEFINITION Human pre-B cell stimulating factor homologue (SDF1b) mRNA, complete cds.

ACCESSION L36033

NID gl220365

KEYWORDS intercrine; intercrine CXC subfamily; pre-B cell stimulating factor

SOURCE homologue; alpha-chemokine.

ORGANISM human.

REFERENCE 1 (bases 1 to 3524)

AUTHORS Shirozu, M., Nakano, T., Inazawa, J., Tashiro, K., Tada, H., Shinohara, T. and Honjo, T.

TITLE Structure and chromosomal localization of the human stromal cell-derived factor 1 (SDF1) gene

JOURNAL Genomics 28 (3), 495-500 (1995)

MEDLINE 96039262

FEATURES

source Location/Qualifiers

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/clone="h17"

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LOCUS HSJ002211 663 bp mRNA  
DEFINITION Homo sapiens cDNA for a CXC chemokine.  
ACCESSION AJ002211

PRI 11-MAR-1998

NID g2832410  
 KEYWORDS CXC chemokine.  
 SOURCE human.  
 ORGANISM Homo sapiens  
 Eukaryota; Metazoa; Chordata; Vertebrata; Mammalia; Eutheria;  
 Primates; Catarrhini; Hominidae; Homo.  
 REFERENCE 1 (bases 1 to 663)  
 AUTHORS Legler, D.F., Loetscher, M., Roos, R.S., Clark-Lewis, I.,  
 Baggiolini, M. and Moser, B.  
 TITLE B cell-attracting chemokine 1, a human CXC chemokine expressed  
 in lymphoid tissues, selectively attracts B lymphocytes via  
 BLR1/CXCR5  
 JOURNAL J. Exp. Med. 187 (4), 655-660 (1998)  
 MEDLINE 98130629  
 REFERENCE 2 (bases 1 to 663)  
 AUTHORS Moser, B.  
 TITLE Direct Submission  
 JOURNAL Submitted (05-NOV-1997) Moser B., University of Bern, Theodor  
 Kocher Institute, Freiestrasse 1, CH-3012 Bern, SWITZERLAND  
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 NID g311375  
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 SOURCE human.  
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 Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;  
 Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.  
 REFERENCE 1 (bases 1 to 2545)  
 AUTHORS Farber, J.M.  
 TITLE Direct Submission  
 JOURNAL Submitted (22-MAR-1993) J.M. Farber, Johns Hopkins Univ. School



of Medicine, Ross 1147, 720 Rutland Avenue, Baltimore, MD 21205,

USA

REFERENCE 2 (bases 1 to 2545)

AUTHORS Farber, J.M.

TITLE HuMig: a new human member of the chemokine family of cytokines

JOURNAL Biochem. Biophys. Res. Commun. 192 (1), 223-230 (1993)

MEDLINE 93236577

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LOCUS HSHUMIG 2545 bp RNA PRI 16-NOV-1993  
 DEFINITION H.sapiens Humig mRNA.  
 ACCESSION X72755 S60728  
 NID g311375  
 KEYWORDS chemokine; cytokine; Humig gene; secreted protein.  
 SOURCE human.  
 ORGANISM Homo sapiens  
 Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;  
 Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.  
 REFERENCE 1 (bases 1 to 2545)  
 AUTHORS Farber, J.M.  
 TITLE Direct Submission  
 JOURNAL Submitted (22-MAR-1993) J.M. Farber, Johns Hopkins Univ. School  
 of Medicine, Ross 1147, 720 Rutland Avenue, Baltimore, MD 21205,  
 USA  
 REFERENCE 2 (bases 1 to 2545)  
 AUTHORS Farber, J.M.  
 TITLE HuMig: a new human member of the chemokine family of cytokines  
 JOURNAL Biochem. Biophys. Res. Commun. 192 (1), 223-230 (1993)  
 MEDLINE 93236577  
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 BASE COUNT 755 a 581 c 457 g 752 t  
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LOCUS      AF002985      995 bp      mRNA      PRI      01-NOV-1997
DEFINITION Homo sapiens putative alpha chemokine (H174) mRNA, complete
cds.
ACCESSION  AF002985
NID        g2580585
KEYWORDS
SOURCE     human.
ORGANISM   Homo sapiens
            Eukaryotae; Metazoa; Chordata; Vertebrata; Mammalia; Eutheria;
            Primates; Catarrhini; Hominidae; Homo.
REFERENCE  1 (bases 1 to 995)
AUTHORS    Jacobs,K.A., Collins-Racie,L.A., Colbert,M., Duckett,M.,
            Golden-Fleet,M., Kelleher,K., Kriz,R., LaVallie,E.R.,
            Merberg,D.,
            Spaulding,V., Stover,J., Williamson,M.J. and McCoy,J.M.
TITLE      A genetic selection for isolating cDNAs encoding secreted
            proteins
JOURNAL    Gene 198 (1-2), 289-296 (1997)
MEDLINE    98036061
REFERENCE  2 (bases 1 to 995)
AUTHORS    Jacobs,K.A., Collins-Racie,L.A., Colbert,M., Duckett,M.,
            Golden-Fleet,M., Kelleher,K., Kriz,R., LaVallie,E.R.,
            Merberg,D.,
            Spaulding,V., Stover,J., Williamson,M.J. and McCoy,J.M.
TITLE      Direct Submission
JOURNAL    Submitted (07-MAY-1997) Genetics Institute, 87 Cambridge Park
            Drive, Cambridge, MA 02140, USA
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LOCUS AF030514 1371 bp mRNA PRI 17-JUN-1998  
 DEFINITION Homo sapiens interferon stimulated T-cell alpha chemoattractant precursor, mRNA, complete cds.  
 ACCESSION AF030514  
 NID g3219692  
 KEYWORDS  
 SOURCE human.  
 ORGANISM Homo sapiens  
 Eukaryota; Metazoa; Chordata; Vertebrata; Mammalia; Eutheria; Primates; Catarrhini; Hominidae; Homo.  
 REFERENCE 1 (bases 1 to 1371)  
 AUTHORS Cole,K.E., Strick,C.A., Paradis,T.J., Ogborne,K.T., Loetscher,M., Gladue,R.P., Lin,W., Boyd,J.G., Moser,B., Wood,D.E., Sahagan,B.G. and Neote,K.  
 TITLE Interferon-inducible T cell alpha chemoattractant (I-TAC): a novel non-ELR CXC chemokine with potent activity on activated T cells through selective high affinity binding to CXCR3  
 JOURNAL J. Exp. Med. 187 (12), 2009-2021 (1998)  
 MEDLINE 98290735  
 REFERENCE 2 (bases 1 to 1371)  
 AUTHORS Cole,K.E., Strick,C.A. and Sahagan,B.G.  
 TITLE Direct Submission  
 JOURNAL Submitted (20-OCT-1997) Molecular Sciences, Pfizer, Inc., Eastern Point Road, Groton, CT 06340, USA  
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	481	ttcaactttt	gtacagttat	gtgaaggatg	aaaggtgggt	gaaaggacca aaaacagaaa
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LOCUS AF030514 1371 bp mRNA PRI 17-JUN-1998

DEFINITION Homo sapiens interferon stimulated T-cell alpha chemoattractant precursor, mRNA, complete cds.

ACCESSION AF030514

NID g3219692

KEYWORDS .

SOURCE human.

ORGANISM Homo sapiens  
Eukaryota; Metazoa; Chordata; Vertebrata; Mammalia; Eutheria;  
Primates; Catarrhini; Hominidae; Homo.

REFERENCE 1 (bases 1 to 1371)

AUTHORS Cole,K.E., Strick,C.A., Paradis,T.J., Ogborne,K.T.,  
Loetscher,M., Gladue,R.P., Lin,W., Boyd,J.G., Moser,B., Wood,D.E.,  
Sahagan,B.G.  
and Neote,K.

TITLE Interferon-inducible T cell alpha chemoattractant (I-TAC): a  
novel non-ELR CXC chemokine with potent activity on activated T cells  
through selective high affinity binding to CXCR3

JOURNAL J. Exp. Med. 187 (12), 2009-2021 (1998)

MEDLINE 98290735

REFERENCE 2 (bases 1 to 1371)

AUTHORS Cole,K.E., Strick,C.A. and Sahagan,B.G.

TITLE Direct Submission

JOURNAL Submitted (20-OCT-1997) Molecular Sciences, Pfizer, Inc.,  
Eastern Point Road, Groton, CT 06340, USA

FEATURES Location/Qualifiers

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BASE COUNT 487 a 228 c 244 g 411 t 1 others  
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LOCUS AF030514 1371 bp mRNA PRI 17-JUN-1998  
 DEFINITION Homo sapiens interferon stimulated T-cell alpha chemoattractant precursor, mRNA, complete cds.  
 ACCESSION AF030514  
 NID g3219692  
 KEYWORDS  
 SOURCE human.  
 ORGANISM Homo sapiens  
 Eukaryota; Metazoa; Chordata; Vertebrata; Mammalia; Eutheria; Primates; Catarrhini; Hominidae; Homo.  
 REFERENCE 1 (bases 1 to 1371)  
 AUTHORS Cole, K.E., Strick, C.A., Paradis, T.J., Ogborne, K.T., Loetscher, M., Gladue, R.P., Lin, W., Boyd, J.G., Moser, B., Wood, D.E., Sahagan, B.G. and Neote, K.  
 TITLE Interferon-inducible T cell alpha chemoattractant (I-TAC): a novel non-ELR CXC chemokine with potent activity on activated T cells through selective high affinity binding to CXCR3  
 JOURNAL J. Exp. Med. 187 (12), 2009-2021 (1998)  
 MEDLINE 98290735  
 REFERENCE 2 (bases 1 to 1371)  
 AUTHORS Cole, K.E., Strick, C.A. and Sahagan, B.G.  
 TITLE Direct Submission  
 JOURNAL Submitted (20-OCT-1997) Molecular Sciences, Pfizer, Inc., Eastern Point Road, Groton, CT 06340, USA  
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chemoattractant"

BASE COUNT 487 a 228 c 244 g 411 t 1 others  
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LOCUS HSMDNCF 1560 bp RNA PRI 31-MAR-1995  
DEFINITION Human mRNA for MDNCF (monocyte-derived neutrophil chemotactic factor).  
ACCESSION Y00787  
NID g34518  
KEYWORDS cytokine.  
SOURCE human.  
ORGANISM Homo sapiens  
Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata; Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.  
REFERENCE 1 (bases 1 to 1560)  
AUTHORS Matsushima, K.  
TITLE Direct Submission  
JOURNAL Submitted (03-MAY-1988) Matsushima K., National Cancer Institute, Bldg 560, Rm 31-19, Frederick, MD 21701  
REFERENCE 2 (bases 1 to 1560)  
AUTHORS Matsushima, K., Morishita, K., Yoshimura, T., Lavu, S., Kobayashi, Y., Lew, W., Appella, E., Kung, H.F., Leonard, E.J. and Oppenheim, J.J.  
TITLE Molecular cloning of a human monocyte-derived neutrophil chemotactic factor (MDNCF) and the induction of MDNCF mRNA by interleukin 1 and tumor necrosis factor  
JOURNAL J. Exp. Med. 167 (6), 1883-1893 (1988)  
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361 gggttgtgga gaagtttttg aagagggtct agaattcata aaaaaattca ttctctgtgg
421 tatccaagaa tcagtgaaga tgccagtga aactcaagca aatctacttc aacacttcat
481 gtattgtgtg ggtctgttgt aggggtgcca gatgcaatac aagattcctg gttaaatttg
541 aatttcagta aacaatgaat agtttttcat tgtaccatga aatatccaga acatacttat
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661 ttttcctaga tattgcacgg gagaatatac aaatagcaaa attgggccaa gggccaagag
721 aatatccgaa ctttaatttc aggaattgaa tgggtttgct agaatgtgat atttgaagca
781 tcacataaaa atgatgggac aataaatttt gccataaagt caaatttagc tggaaatcct
841 ggattttttt ctgttaaate tggcaaccct agtctgctag ccaggatcca caagtccttg
901 tccactgtg ccttggtttc tcctttattt ctaagtggaa aaagtattag ccaccatctt
961 acctcacag gatgttgtga ggacatgtgg aagcacttta agttttttca tcataacata
1021 aattattttc aagtgttaact tattaacctt tttattttt atgtatttat ttaagcatca
1081 aatatttgtg caagaatttg gaaaaataga agatgaatca ttgattgaat agttataaag
1141 atgttatagt aaatttattt tatttttagat attaaatgat gttttattag ataaatttca
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1321 actaacaatc ctagtttgat actcccagtc ttgtcattgc cagctgtgtt ggtagtgctg
1381 tgttgaatta cggaataatg agttagaact attaaaacag caaaactcc acagtcaata
1441 ttagtaattt cttgctgggt gaaacttggt tattatgtac aaatagattc ttataatatt
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LOCUS      HSINFGF 1172 bp RNA PRI 21-MAR-1995
DEFINITION Human mRNA for gamma-interferon inducible early response gene
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ACCESSION  X02530 M17752
NID        g33917
KEYWORDS   interferon response; signal peptide.
SOURCE     human.
ORGANISM   Homo sapiens
            Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;
            Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.
REFERENCE  1 (bases 1 to 1172)
AUTHORS    Luster,A.D., Unkeless,J.C. and Ravetch,J.V.
TITLE      Gamma-interferon transcriptionally regulates an early-response
gene
            containing homology to platelet proteins
JOURNAL     Nature 315 (6021), 672-676 (1985)
MEDLINE     85240552
REFERENCE  2 (bases 1 to 1172)
AUTHORS     Luster,A.D.
TITLE       Direct Submission
JOURNAL     Submitted (29-JUL-1986) to the EMBL/GenBank/DDBJ databases
COMMENT     Data kindly reviewed (29-JUL-1986) by Luster A.D.
FEATURES    Location/Qualifiers
            source          1..1172
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                        /strain="(U 937 histiocytic lymphoma cell line)"
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            misc_RNA        1
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 CDS 67..363  
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 /db\_xref="PID:g33918"  
 /db\_xref="SWISS-PROT:P02778"

/translation="MNQTAILICCLIFLTLSGIQGVPLSRTVRCISISNQPVNPRS

LEKLEIIPASQFCPRVEIIATMKKKGKRCNPNESKAIKNLLKAVSKEMSKRSP"

mat\_peptide 130..360  
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 /note="ugaa was uga in [1]"  
 /citation=[1]  
 old\_sequence 1146..1148  
 /note="caa was ca in [1]"  
 /citation=[1]  
 misc\_feature 1155..1160  
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BASE COUNT 384 a 231 c 208 g 349 t  
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121 attcaaggag tacctctctc tagaaccgta cgctgtacct gcatcagcat tagtaatcaa
181 cctgttaatc caagggtctt agaaaaactt gaaattattc ctgcaagcca attttgtcca
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361 taaaaccaga ggggagcaaa atcgatgcag tgcttccaag gatggaccac acagaggctg
421 cctctcccat cacttcctca catggagtat atgtcaagcc ataattgttc ttagtttgca
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721 tcagaatctc aaataactaa aagggtatgc atcaaactcg ctttttaaag aatgctcttt
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1021 ttttaaaaat acagatagat atatgctctg catgttacat aagataaatg tgctgaatgg
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1141 aagatcaaaa ggtaataaaa gtaattataa ct

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LOCUS SYNRP4A 225 bp DNA SYN 15-JUN-1989  
 DEFINITION Human recombinant platelet factor 4 (PF4) gene, complete cds.  
 ACCESSION M20901  
 NID g209285  
 KEYWORDS platelet factor; platelet factor 4.  
 SOURCE Synthetic oligonucleotide DNA, clone pIN-III-ompA-2.  
 ORGANISM artificial sequence  
 artificial sequence.  
 REFERENCE 1 (bases 1 to 225)  
 AUTHORS Barone,A.D., Ghayeb,J., Hammerling,U., Zucker,M.B. and  
 Thorbecke,G.J.  
 TITLE The expression in Escherichia coli of recombinant human  
 platelet  
 factor 4, a protein with immunoregulatory activity  
 JOURNAL J. Biol. Chem. 263, 8710-8715 (1988)  
 MEDLINE 88243725  
 FEATURES Location/Qualifiers  
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 /codon\_start=2

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/db\_xref="PID:g209286"

/translation="ASMEAEDGDLQCLCVKTTTSQVRPRHITSLEVIKAGPHCPTAQL  
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BASE COUNT 59 a 59 c 51 g 56 t  
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1 agcttctatg gaagctgaag aagacgggtga cctgcagtgc ctgtgcgtta aaactacttc  
61 tcagggttcgt ccgctgcata tcacttctct ggaagttatc aaagctgggc cgcattgccc  
121 gactgctcag ctgacgcgta ctctcaaaga cggctgtaaa atctgcctgg acctgcaggg  
181 tccgctgtac aaaaaaatca tcaaaaaact gctggaatct ggatc  
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LOCUS HUMGRO 1050 bp mRNA PRI 11-JUN-1993  
DEFINITION Human gro (growth regulated) gene.  
ACCESSION J03561  
NID g183622  
KEYWORDS gro gene; tumor cell.  
SOURCE Human bladder tumor cell (T24) cDNA to mRNA.  
ORGANISM Homo sapiens  
Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;  
Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.  
REFERENCE 1 (bases 1 to 1050)  
AUTHORS Anisowicz, A., Bardwell, L. and Sager, R.  
TITLE Constitutive overexpression of a growth-regulated gene in  
transformed Chinese hamster and human cells  
JOURNAL Proc. Natl. Acad. Sci. U.S.A. 84, 7188-7192 (1987)  
MEDLINE 88041072  
COMMENT Draft entry and computer-readable sequence kindly submitted by  
R. Sager (20-NOV-1987).  
FEATURES  
source Location/Qualifiers  
1..1050  
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CDS 54..377  
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/db\_xref="PID:g306806"

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CLQTLQGIHPKNIQSVNVKSPGPHCAQTEVIATLKNRKAACLNPA SPIVKKIIEKMLN  
SDKSN"

mat\_peptide 141..374

/note="gro mature protein (put.); putative"

BASE COUNT 270 a 246 c 239 g 295 t  
ORIGIN 52 bp upstream of NcoI site.

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121 tgctcctggg agccgctggc cggcgcgag caggagcgtc cgtggccact gaactgcgct  
181 gccagtgcct gcagaccctg caggggaattc accccaagaa catccaaagt gtgaacgtga  
241 agtcccccg accccactgc gcccaaaccg aagtcatagc cacactcaag aatgggcgga  
301 aagcttgccct caatcctgca tcccccatag ttaagaaaat catcgaaaag atgctgaaca  
361 gtgacaaatc caactgacca gaaggaggga ggaagctcac tgggtggctgt tcctgaagga  
421 ggccctgccc ttataggaac agaagaggaa agagagacac agctgcagag gccacctgga  
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541 tagttttgaa gattctatgt taatatttta ggtgtaaaat aattaagggt atgattaact  
601 ctacctgcac actgtcctat tatattcatt ctttttgaaa tgtcaacccc aagttagttc  
661 aatctggatt catatttaat ttgaaggtag aatgttttca aatgttctcc agtcattatg  
721 ttaatatattc tgaggagcct gcaacatgcc agccactgtg atagaggctg gcggatccaa  
781 gcaaatggcc aatgagatca ttgtgaaggc aggggaatgt atgtgcacat ctgttttgta  
841 actgtttaga tgaatgtcag ttgttattta ttgaaatgat ttcacagtgt gtggtcaaca  
901 tttctcatgt tgaaacttta agaactaaaa tgttctaaat atcccttgga cattttatgt  
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1021 caaaggggct taattattga tgttttcgga  
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LOCUS HUMGROB5 1110 bp mRNA PRI 07-MAR-1995  
DEFINITION Human cytokine (GRO-beta) mRNA, complete cds.



ACCESSION M36820  
 NID g183628  
 KEYWORDS cytokine.  
 SOURCE Human lymphocyte, cDNA to mRNA, clone GRO-beta.  
 ORGANISM Homo sapiens  
 Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;  
 Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.  
 REFERENCE 1 (bases 1 to 1110)  
 AUTHORS Haskill, S., Peace, A., Morris, J., Sporn, S.A., Anisowicz, A.,  
 Lee, S.W., Smith, T., Martin, G., Ralph, P. and Sager, R.  
 TITLE Identification of three related human GRO genes encoding  
 cytokine  
 functions  
 JOURNAL Proc. Natl. Acad. Sci. U.S.A. 87 (19), 7732-7736 (1990)  
 MEDLINE 91017578  
 COMMENT Draft entry and computer-readable sequence for [Proc. Natl.  
 Acad. Sci. U.S.A. (1990) In press] kindly submitted  
 by S.Haskill, 20-JUL-1990.  
 FEATURES  
 source Location/Qualifiers  
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 /db\_xref="taxon:9606"  
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 CDS 75..398  
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 NGKSN"

BASE COUNT 300 a 247 c 247 g 316 t  
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961 aaatatccct tggcatttta tgtctttctt gtaagatact gccttgttta atgttaatta
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LOCUS HUMGROG5 1064 bp mRNA PRI 07-MAR-1995  
 DEFINITION Human cytokine (GRO-gamma) mRNA, complete cds.  
 ACCESSION M36821  
 NID g183632  
 KEYWORDS cytokine.  
 SOURCE Human lymphocyte, cDNA to mRNA, clone GRO-gamma.  
 ORGANISM Homo sapiens  
 Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;  
 Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.  
 REFERENCE 1 (bases 1 to 1064)  
 AUTHORS Haskill, S., Peace, A., Morris, J., Sporn, S.A., Anisowicz, A.,



TITLE cytokine  
 JOURNAL Proc. Natl. Acad. Sci. U.S.A. 87 (19), 7732-7736 (1990)  
 MEDLINE 91017578  
 COMMENT Draft entry and computer-readable sequence for [Proc. Natl. Acad. Sci. U.S.A. (1990) In press] kindly submitted by S.Haskill, 20-JUL-1990.  
 FEATURES  
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BASE COUNT 281 a 237 c 239 g 305 t 2 others  
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121  tcctgcgggt  ggcgtgtgtg  ctctgtctcc  tgggtgggcag  ccggcgcgca  gcaggagcgt
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481  aaaagagaac  agcagctttc  tagggacagc  tggaaaggga  cttaatgtgt  ttgactatgt
541  cttacgaggg  ttctacttat  ttatgtatgt  atttttgaaa  gcttgatatt  taatatatta
601  catgctgtta  tttaaagatg  tgagtgtgtt  tcatcaaaca  tagctcagtc  ctgattatgt
661  aattggaata  tgatgggttt  taaatgtgtc  attaaactaa  tatttagtgg  gagaccataa
721  tgtgtcagcc  acctgataa  atgacagggt  ggggaactgg  agggtngggg  gattgaaatg
781  caagcaatta  gtggatcact  gttagggtta  gggaatgtat  gtacacatct  attttttata
841  cttttttttt  taaaaaagaa  tgctagttgt  tatttattca  aattatctca  cattatgtgt
901  tcaacatttt  tatgtgaag  tttcccttag  acattttatg  tcttgcttgt  agggcataat
961  gccttggtta  atgtccatc  tgcagcggtt  ctctttccct  tggaaaagag  aatttatcat
1021  tactgttaca  tttgtacaaa  tgacatgata  ataaaagttt  tatg
  
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LOCUS HUMCTAP3 673 bp mRNA PRI 06-MAR-1995  
 DEFINITION Human connective tissue activation peptide III mRNA, complete cds.  
 ACCESSION M54995 M38441  
 NID gl81175  
 KEYWORDS connective tissue activating peptide-III; platelet basic protein; thromboglobulin.  
 SOURCE Human platelet, cDNA to mRNA, clone lambda-c[1,2].  
 ORGANISM Homo sapiens  
   Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata; Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.  
 REFERENCE 1 (bases 1 to 673)  
 AUTHORS Wenger, R.H., Wicki, A.N., Walz, A., Kieffer, N. and Clemetson, K.J.  
 TITLE Cloning of cDNA coding for connective tissue activating peptide III  
   from a human platelet-derived lambda gt11 expression library  
 JOURNAL Blood 73 (6), 1498-1503 (1989)  
 MEDLINE 89229374  
 FEATURES  
   source Location/Qualifiers  
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     /db_xref="PID:g181176"

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mat_peptide 208..450
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             /note="G00-127-391"
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polyA_site 673
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421 aaaaaattgg caggtgatga atctgctgat taatttggtc tgtttctgcc aaacttctt
481 aactcccagg aagggtagaa ttttgaaacc ttgattttct agagttctca tttattcagg
541 atacctattc ttactgtatt aaaatttggg tatgtgtttc attctgtctc aaaaatcaca
601 ttttattctg agaaggttgg ttaaaagatg gcagaaagaa gatgaaaata aataagcctg
661 gtttcaaccc tct

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LOCUS HUMENA78A 2177 bp DNA PRI 31-JAN-1996
DEFINITION Homo sapiens neutrophil-activating peptide 78 (ENA-78) gene,
complete cds.
ACCESSION L37036 246254
NID g607030
KEYWORDS ENA-78 gene; homologue; neutrophil-activating factor;
neutrophil-activating peptide 78.
SOURCE Homo sapiens DNA.
ORGANISM Homo sapiens
Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;
Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.
REFERENCE 1 (bases 1 to 2177)
AUTHORS Walz,A., Burgener,R., Car,B., Baggiolini,M., Kunkel,S.L. and
Strieter,R.M.
TITLE Structure and neutrophil-activating properties of a novel
inflammatory peptide (ENA-78) with homology to interleukin 8
JOURNAL J. Exp. Med. 174 (6), 1355-1362 (1991)
MEDLINE 92078844
REFERENCE 2 (bases 1 to 2177)
AUTHORS Walz,A.

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TITLE Direct Submission  
 JOURNAL Submitted (14-OCT-1994) A. Walz, University of Bern, Theodor  
 Kocher Institute, Freiestr. 1, Bern, Switzerland 3012  
 REFERENCE 3 (bases 1 to 2177)  
 AUTHORS Corbett, M.S., Schmitt, I., Riess, O. and Walz, A.  
 TITLE Characterization of the gene for human neutrophil-activating  
 peptide 78 (ENA-78)  
 JOURNAL Biochem. Biophys. Res. Commun. 205 (1), 612-617 (1994)  
 MEDLINE 95091791  
 FEATURES  
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 ACCESSION Y08770  
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 KEYWORDS cell surface receptor; CXC chemokine; GCP-2 gene; granulocyte chemotactic protein.  
 SOURCE human.  
 ORGANISM Homo sapiens  
 Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata; Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.  
 REFERENCE 1 (bases 1 to 254)  
 AUTHORS Froyen,G., Proost,P., Ronsse,I., Mitera,T., Haelens,A., Wuyts,A.,  
 Opdenakker,G., Van Damme,J. and Billiau,A.  
 TITLE Cloning, bacterial expression and biological characterization  
 of recombinant human granulocyte chemotactic protein-2 and differential expression of granulocyte chemotactic protein-2 and epithelial cell-derived neutrophil activating peptide-78 mRNAs  
 JOURNAL Eur. J. Biochem. 243 (3), 762-769 (1997)  
 MEDLINE 97210779  
 REFERENCE 2 (bases 1 to 254)  
 AUTHORS Froyen,G.F.V.  
 TITLE Direct Submission  
 JOURNAL Submitted (10-OCT-1996) G.F.V. Froyen, Rega Institute, University of Leuven, Minderbroedersstraat 10, B-3000 Leuven, BELGIUM  
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DEFINITION Human DNA for SCM-1beta precursor, complete cds.
ACCESSION  D63789
NID        g1754608
KEYWORDS   SCM-1beta; SCM-1beta precursor.
SOURCE     Homo sapiens placenta DNA, clone:hg44.
ORGANISM   Homo sapiens
            Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;
            Vertebrata; Mammalia; Eutheria; Primates; Catarrhini;
            Hominidae; Homo.
REFERENCE  1 (sites)
AUTHORS    Yoshida,T., Imai,T., Kakizaki,M., Nishimura,M. and Yoshie,O.
TITLE      Molecular cloning of a novel C or gamma type chemokine, SCM-1
JOURNAL    FEBS Lett. 360 (2), 155-159 (1995)
MEDLINE    95180438
REFERENCE  2 (sites)
AUTHORS    Yoshida,T., Imai,T., Takagi,S., Nishimura,M., Ishikawa,I.,
            Yaoi,T.
            and Yoshie,O.
TITLE      Structure and expression of two highly related genes encoding
            SCM-1/human lymphotactin
JOURNAL    FEBS Lett. 395 (1), 82-88 (1996)
MEDLINE    97002294
REFERENCE  3 (bases 1 to 5669)
AUTHORS    Yoshida,T.
JOURNAL    Unpublished (1995)
REFERENCE  4 (bases 1 to 5669)
AUTHORS    Yoshida,T.
TITLE      Direct Submission
JOURNAL    Submitted (07-AUG-1995) to the DDBJ/EMBL/GenBank databases.
Tetsuya    Yoshida, Shionogi Institute for Medical Science; 2-5-1,
Mishima,   Settsu, Osaka 566, Japan (E-
            mail:teyoshid@fl.lab.shionogi.co.jp,
            Tel:06-382-2612, Fax:06-382-2598)
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DEFINITION Human DNA for SCM-lalpha precursor, complete cds.
ACCESSION  D63790
NID        g1754610
KEYWORDS   SCM-lalpha precursor; SCM-1 alpha.
SOURCE      Homo sapiens placenta DNA, clone:hg40.
ORGANISM   Homo sapiens
            Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;
            Vertebrata; Mammalia; Eutheria; Primates; Catarrhini;
Hominidae; Homo.
REFERENCE  1 (sites)
AUTHORS    Yoshida,T., Imai,T., Kakizaki,M., Nishimura,M. and Yoshie,O.
TITLE      Molecular cloning of a novel C or gamma type chemokine, SCM-1
JOURNAL     FEBS Lett. 360 (2), 155-159 (1995)

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MEDLINE 95180438  
 REFERENCE 2 (sites)  
 AUTHORS Yoshida,T., Imai,T., Takagi,S., Nishimura,M., Ishikawa,I.,  
 Yaoi,T.  
 and Yoshie,O.  
 TITLE Structure and expression of two highly related genes encoding  
 SCM-1/human lymphotactin  
 JOURNAL FEBS Lett. 395 (1), 82-88 (1996)  
 MEDLINE 97002294  
 REFERENCE 3 (bases 1 to 5660)  
 AUTHORS Yoshida,T.  
 JOURNAL Unpublished (1995)  
 REFERENCE 4 (bases 1 to 5660)  
 AUTHORS Yoshida,T.  
 TITLE Direct Submission  
 JOURNAL Submitted (07-AUG-1995) to the DDBJ/EMBL/GenBank databases.  
 Tetsuya Yoshida, Shionogi Institute for Medical Science; 2-5-1,  
 Mishima, Settsu, Osaka 566, Japan (E-  
 mail:teyoshid@fl.lab.shionogi.co.jp,  
 Tel:06-382-2612, Fax:06-382-2598)  
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AUTHORS    Bazan,J.F., Bacon,K.B., Hardiman,G., Wang,W., Soo,K., Rossi,D.,
            Greaves,D.R., Zlotnik,A. and Schall,T.J.
TITLE      A new class of membrane-bound chemokine with a CX3C motif
JOURNAL    Nature 385 (6617), 640-644 (1997)
MEDLINE    97177111
REFERENCE  2 (bases 1 to 1635)
AUTHORS    Bazan,J.F., Bacon,K.B., Hardiman,G., Wang,W., Rossi,D.,
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TITLE      Direct Submission
JOURNAL    Submitted (03-MAR-1997) Molecular Biology, DNAX Research
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 AUTHORS Bazan,J.F., Bacon,K.B., Hardiman,G., Wang,W., Soo,K., Rossi,D.,  
 Greaves,D.R., Zlotnik,A. and Schall,T.J.  
 TITLE A new class of membrane-bound chemokine with a CX3C motif  
 JOURNAL Nature 385 (6617), 640-644 (1997)  
 MEDLINE 97177111  
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 AUTHORS Bazan,J.F., Bacon,K.B., Hardiman,G., Wang,W., Rossi,D.,  
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DEFINITION Homo sapiens IL-10-inducible chemokine (HCC-4) mRNA, complete
cds.
ACCESSION  U91746
NID        g2581780
KEYWORDS
SOURCE     human.
ORGANISM   Homo sapiens
            Eukaryotae; mitochondrial eukaryotes; Metazoa; Chordata;
            Vertebrata; Eutheria; Primates; Catarrhini; Hominidae; Homo.
REFERENCE  1 (bases 1 to 1430)
AUTHORS    Hedrick, J.A., Helms, A., Gorman, D. and Zlotnik, A.
TITLE      Identification of a novel human CC chemokine upregulated by IL-
10
JOURNAL     Blood (1998) In press
REFERENCE  2 (bases 1 to 1430)
AUTHORS     Hedrick, J.A., Helms, A., Gorman, D. and Zlotnik, A.
TITLE      Direct Submission
JOURNAL     Submitted (02-MAR-1997) Immunology, DNAX Research Institute,
901         California Ave, Palo Alto, CA 94304, USA
FEATURES
source      Location/Qualifiers
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            /product="IL-10-inducible chemokine"
            /db_xref="PID:g2581781"

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BASE COUNT 401 a 351 c 293 g 385 t

ORIGIN

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//



## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US98/26291

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : Please See Extra Sheet.

US CL : Please See Extra Sheet.

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 424/84, 85.1, 184.1, 186.1, 188.1, 278.1; 514/2, 8, 12, 44; 530/300, 324

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
NONEElectronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
Please See Extra Sheet.

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,141, 867 A (IVANOFF et al.) 25 August 1992, see entire document.	22-32, 45-55
A	ENG et al. The Stimulatory Effects of Interleukin (IL)-12 On Hematopoiesis Are Antagonized by IL-12-induced Interferon $\gamma$ In Vivo. J. Exp. Med. May 1995, Vol.181, pages 1893-1898, see entire document.	1-21, 33-44
A	ORANGE et al. Mechanism of Interleukin 12-mediated Toxicities during Experimental Viral Infections: Role of Tumor Necrosis Factor and Glucocorticoids. J. Exp. Med. March 1995, Vol.181, pages 901-914, see entire document.	1-21, 33-44

☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
*A* document defining the general state of the art which is not considered to be of particular relevance	*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
*E* earlier document published on or after the international filing date	*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
*L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*Z* document member of the same patent family
*O* document referring to an oral disclosure, use, exhibition or other means	
*P* document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

25 MARCH 1999

Date of mailing of the international search report

15 APR 1999

Name and mailing address of the ISA/US  
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## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US98/26291

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WU et al. Receptor-mediated in Vitro Gene Transformation by a Soluble DNA Carrier System. The Journal of Biological Chemistry. 05 April 1987, Vol.252, No. 10, pages 4429-4432, see entire document.	22-32, 45-55

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US98/26291

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2. ☐ Claims Nos.:  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
  
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Please See Extra Sheet.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
  
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.  
☐ No protest accompanied the payment of additional search fees.

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US98/26291

## A. CLASSIFICATION OF SUBJECT MATTER: IPC (6):

C07K 14/47, 14/52; C12N 15/12, 15/19, 15/63; A61K 38/16, 38/19, 48/00

## A. CLASSIFICATION OF SUBJECT MATTER: US CL :

424/84, 85.1, 184.1, 186.1, 188.1, 278.1; 514/2, 8, 12, 44; 530/300, 324

## B. FIELDS SEARCHED

Electronic data bases consulted (Name of data base and where practicable terms used):

APS, CAN ONLINE, MEDLINE, CAPLUS

search terms: chemokine, vaccination, immunogenic, antigen, HIV, efficacy, macrophage-derived chemokine, stromal cell-derived factor, monocyte chemotactic protein, composition, administration

## BOX II. OBSERVATIONS WHERE UNITY OF INVENTION WAS LACKING

This ISA found multiple inventions as follows:

This application contains the following inventions or groups of inventions which are not so linked as to form a single inventive concept under PCT Rule 13.1.

Group I, claims 1-21, 33-44, drawn to a method to enhance the efficacy of a vaccine in a subject comprising administering an antigen and one or more chemokines and a composition thereto.

Group II, claims 22-32, 45-55, drawn to a method to enhance the efficacy of a vaccine in a subject comprising administering nucleic acid sequences encoding one or more antigens and nucleic acid sequences encoding one or more chemokines.

The inventions listed as Groups I-II do not relate to a single inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

The inventions listed as Groups I-II do not relate to a single inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Pursuant to 37 C.F.R. § 1.475 (d), the ISA/US considers that where multiple products and processes are claimed, the main invention shall consist of the first invention of the category first mentioned in the claims and the first recited invention of each of the other categories related thereto. Accordingly, the main invention (Group I) comprises the first-recited product and method, a method to enhance the efficacy of a vaccine in a subject comprising administering an antigen and one or more chemokines and a composition thereto. Further pursuant to 37

C.F.R. § 1.475 (d), the ISA/US considers that any feature which the subsequently recited products and methods share with the main invention does not constitute a special technical feature within the meaning of PCT Rule 13.2 and that each of such products and methods accordingly defines a separate invention.